

**IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE**

UNILIN BEHEER B.V. and
FLOORING INDUSTRIES LTD., SARL

Plaintiffs,

v.

PERGO (EUROPE) AB and
PERGO LLC

Defendants.

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C.A. No. _____

JURY TRIAL DEMANDED

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiffs Unilin Beheer B.V. (“Unilin Beheer”) and Flooring Industries Ltd., sarl (“Flooring Industries”) (collectively, “Plaintiffs” or “Unilin”) hereby bring this complaint for patent infringement against Defendants Pergo (Europe) AB and Pergo LLC.

THE PARTIES

1. Unilin Beheer is a Dutch corporation with its principal place of business at Hoogeveenweg 28, 2913 LV Nieuwerkerk Ad Ijssel, Netherlands.
2. Flooring Industries is an Irish corporation with its principal place of business at 10b, rue des Merovingiens, ZI Bourmicht, L-8070 Bertrange, Luxembourg.
3. Upon information and belief, Pergo (Europe) AB (“Pergo AB”) is a Swedish corporation with its principal place of business in Trelleborg, Sweden.
4. Upon information and belief, Pergo LLC is a Delaware Limited Liability Company with its principal place of business in Raleigh, North Carolina.

THE ACCUSED PRODUCTS

5. Upon information and belief, Pergo AB and Pergo LLC (collectively, “Pergo”) are in the business of manufacturing, importing, selling and/or offering to sell

laminated floor panels (the "Accused Products") in the United States, including in the District of Delaware.

6. The Accused Products are available for purchase at Home Depot and Lowe's stores throughout the United States, including the District of Delaware, as well as over the internet and at other retail locations across the United States. The Accused Products are sold under a variety of brand names and styles, including but not limited to Everyday, Accolade, Accolade Tiles, Vintage Home, Naturals, Preferred, Select, American Cottage, Casual Living, Presto, Global Passage and World Traveler.

THE UNILIN PATENTS

7. Unilin Beheer is the sole and exclusive owner of U.S. Patent No. 6,006,486 (the "'486 patent"), duly and legally issued by the United States Patent and Trademark Office ("PTO") on December 28, 1999. The '486 patent, entitled "Floor Panel with Edge Connectors," identifies Stefan Simon Gustaaf Moriau, Mark Gaston Maurits Cappelle, and Bernard Paul Joseph Thiers as the named inventors. A true and correct copy of the '486 patent is attached hereto as Exhibit A.

8. Unilin Beheer is the sole and exclusive owner of U.S. Patent No. 6,490,836 B1 (the "'836 patent"), duly and legally issued by the PTO on December 10, 2002. The '836 patent has the same title and named inventors as set forth in Paragraph 7 above. A true and correct copy of the '836 patent is attached hereto as Exhibit B.

9. Unilin Beheer is the sole and exclusive owner of U.S. Patent No. 6,874,292 B2 (the "'292 patent"), duly and legally issued by the PTO on April 5, 2005. The '292 patent has the same title and named inventors as set forth in Paragraph 7 above. A true and correct copy of the '292 patent is attached hereto as Exhibit C.

10. Unilin Beheer is the sole and exclusive owner of U.S. Patent No. 6,928,779 B2 (the "'779 patent"), duly and legally issued by the PTO on August 16, 2005. The '779 patent has the same title and named inventors as set forth in Paragraph 7 above. A true and correct copy of the '779 patent is attached hereto as Exhibit D.

11. Unilin Beheer is the sole and exclusive owner of U.S. Patent No. 6,955,020 B2 (the "'020 patent"), duly and legally issued by the PTO on October 18, 2005. The '020 patent has the same title and named inventors as set forth in Paragraph 7 above. A true and correct copy of the '020 patent is attached hereto as Exhibit E.

12. Unilin Beheer is the sole and exclusive owner of U.S. Patent No. 6,993,877 B2 (the "'877 patent"), duly and legally issued by the PTO on February 7, 2006. The '877 patent has the same title and named inventors as set forth in Paragraph 7 above. A true and correct copy of the '877 patent is attached hereto as Exhibit F.

13. Unilin Beheer is the sole and exclusive owner of U.S. Patent No. 7,040,068 B2 (the "'068 patent"), duly and legally issued by the PTO on May 9, 2006. The '068 patent has the same title and named inventors as set forth in Paragraph 7 above. A true and correct copy of the '068 patent is attached hereto as Exhibit G.

14. Unilin Beheer is the sole and exclusive owner of U.S. Patent No. 7,328,536 B2 (the "'536 patent"), duly and legally issued by the PTO on February 12, 2008. The '536 patent has the same title and named inventors as set forth in Paragraph 7 above. A true and correct copy of the '536 patent is attached hereto as Exhibit H.

15. Flooring Industries is the sole and exclusive owner of U.S. Patent No. 6,786,019 B2 (the "'019 patent"), duly and legally issued by the PTO on September 7, 2004.

The '019 patent, entitled "Floor Covering," identifies Bernard Paul Joseph Thiers as the named inventor. A true and correct copy of the '019 patent is attached hereto as Exhibit I.

16. Pergo has been and is knowingly and willfully infringing or actively inducing infringement of the '486, '836, '292, '779, '020, '877, '068, '536, and '019 patents (the "Unilin Patents") by making, causing to be made, using, causing to be used, offering for sale, causing to be offered for sale, selling, causing to be sold, importing, or causing to be imported in the United States and the District of Delaware the Accused Products.

JURISDICTION AND VENUE

17. This claim arises under the patent laws of the United States, 35 U.S.C. § 101, *et seq.* This Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

18. This Court has personal jurisdiction over Pergo AB because, upon information and belief, Pergo AB directly or through others sells and/or offers to sell the Accused Products in the District of Delaware, and also because Pergo AB conducts regular and substantial business in this judicial district.

19. This Court has personal jurisdiction over Pergo LLC because Pergo LLC is a Delaware Limited Liability Company. Furthermore, this Court has personal jurisdiction over Pergo LLC because, upon information and belief, Pergo LLC directly or through others sells and/or offers to sell the Accused Products in the District of Delaware, and also because Pergo LLC conducts regular and substantial business in this judicial district.

20. Upon information and belief, venue is proper in this Court under 28 U.S.C. §§ 1391(b) and (c) and 1400(b).

COUNT I
(Infringement of United States Patent No. 6,006,486)

21. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

22. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '486 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the infringement of the '486 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

23. Pergo's infringement of the '486 patent has occurred with knowledge of the '486 patent, has been willful, and continues to be willful.

24. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '486 patent and has no adequate remedy of law.

COUNT II
(Infringement of United States Patent No. 6,490,836 B1)

25. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

26. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '836 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the infringement of the '836 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

27. Pergo's infringement of the '836 patent has occurred with knowledge of the '836 patent, has been willful, and continues to be willful.

28. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '836 patent and has no adequate remedy of law.

COUNT III
(Infringement of United States Patent No. 6,874,292 B2)

29. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

30. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '292 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the infringement of the '292 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

31. Pergo's infringement of the '292 patent has occurred with knowledge of the '292 patent, has been willful, and continues to be willful.

32. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '292 patent and has no adequate remedy of law.

COUNT IV
(Infringement of United States Patent No. 6,928,779 B2)

33. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

34. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '779 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the

infringement of the '779 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

35. Pergo's infringement of the '779 patent has occurred with knowledge of the '779 patent, has been willful, and continues to be willful.

36. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '779 patent and has no adequate remedy of law.

COUNT V
(Infringement of United States Patent No. 6,955,020 B2)

37. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

38. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '020 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the infringement of the '020 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

39. Pergo's infringement of the '020 patent has occurred with knowledge of the '020 patent, has been willful, and continues to be willful.

40. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '020 patent and has no adequate remedy of law.

COUNT VI
(Infringement of United States Patent No. 6,993,877 B2)

41. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

42. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '877 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the infringement of the '877 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

43. Pergo's infringement of the '877 patent has occurred with knowledge of the '877 patent, has been willful, and continues to be willful.

44. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '877 patent and has no adequate remedy of law.

COUNT VII
(Infringement of United States Patent No. 7,040,068 B2)

45. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

46. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '068 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the infringement of the '068 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

47. Pergo's infringement of the '068 patent has occurred with knowledge of the '068 patent, has been willful, and continues to be willful.

48. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '068 patent and has no adequate remedy of law.

COUNT VIII
(Infringement of United States Patent No. 7,328,536 B2)

49. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

50. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '536 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the infringement of the '536 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

51. Pergo's infringement of the '536 patent has occurred with knowledge of the '536 patent, has been willful, and continues to be willful.

52. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '536 patent and has no adequate remedy of law.

COUNT IX
(Infringement of United States Patent No. 6,786,019 B2)

53. Unilin incorporates herein by reference Paragraphs 1 through 20 of this Complaint as if set forth in full.

54. Pergo has made, used, offered for sale, sold, and/or imported in or into the United States Accused Products that infringe one or more claims of the '019 patent either directly or under the doctrine of equivalents and has contributed to and/or induced the infringement of the '019 patent by others, including by advertising, selling, offering for sale, or teaching a method of using such product to other parties, including its customers.

55. Pergo's infringement of the '019 patent has occurred with knowledge of the '019 patent, has been willful, and continues to be willful.

56. Unilin has sustained and will continue to suffer irreparable injury as a result of Pergo's past and continuing infringement of the '019 patent and has no adequate remedy of law.

PRAYER FOR RELIEF

WHEREFORE, Unilin Beheer and Flooring Industries request that the Court enter judgment on the claims against Pergo as follows:

- (i) Finding that Pergo has infringed the Unilin Patents, either directly, contributorily, or by inducement, in violation of 35 U.S.C. § 271;
- (ii) Entering a permanent injunction prohibiting Pergo, and all those in concert with it, from actively inducing or continuing infringement of the Unilin Patents;
- (iii) Finding that Pergo's infringement of the Unilin Patents was willful;
- (iv) Awarding, pursuant to 35 U.S.C. § 284, damages adequate to compensate for Pergo's infringement of the Unilin Patents, in an amount to be determined at trial, but in no event less than a reasonable royalty;
- (v) Awarding, pursuant to 35 U.S.C. § 284, enhanced damages to Unilin in view of Pergo's willful and wanton infringement of the Unilin Patents;
- (vi) Awarding, pursuant to 35 U.S.C. § 284, Unilin interest on the damages and its costs incurred in this action;
- (vii) Declaring that this case is exceptional pursuant to 35 U.S.C. § 285 and awarding to Unilin its reasonable attorneys' fees, expenses, and costs incurred in this action; and
- (viii) Awarding any other and further relief as this Court may deem just and proper.

JURY DEMAND

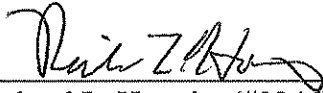
Unilin Beheer and Flooring Industries hereby demand trial by jury on all issues triable to a jury.

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*Attorneys for Plaintiffs Unilin Beheer B.V. and
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EXHIBIT A



US006006486A

United States Patent [19][11] **Patent Number:** **6,006,486****Moriau et al.**[45] **Date of Patent:** **Dec. 28, 1999**[54] **FLOOR PANEL WITH EDGE CONNECTORS**

[75] Inventors: **Stefan Simon Gustaaf Moriau**, Gent;
Mark Gaston Maurits Cappelle,
 Staden; **Bernard Paul Joseph Thiers**,
 Oostrozebeke, all of Belgium

[73] Assignee: **Unilin Beheer BV, besloten
 vennootschap**, IJssel, Netherlands

[21] Appl. No.: **08/872,044**[22] Filed: **Jun. 10, 1997**[30] **Foreign Application Priority Data**

Jun. 11, 1996 [BE] Belgium 09600527
 Apr. 15, 1997 [BE] Belgium 09700344

[51] **Int. Cl.⁶** **E04B 2/08**

[52] **U.S. Cl.** **52/589.1; 52/592.1; 52/586.1;**
52/590.2; 52/592.3

[58] **Field of Search** **52/578 B, 589.1,**
52/592.1, 570, 571, 572, 590.2, 586.1,
592.3, 591.1, 590.1

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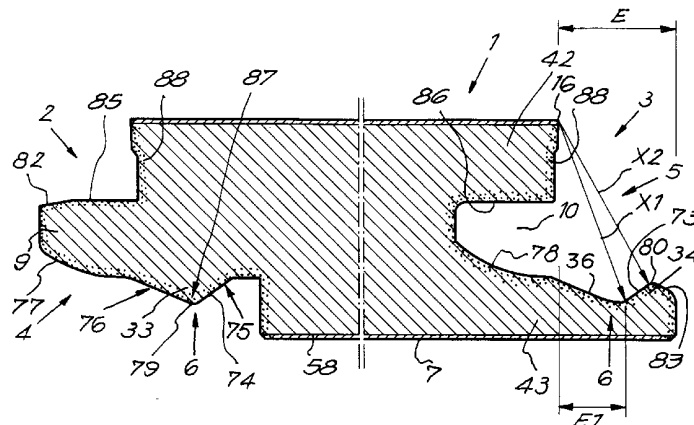
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Primary Examiner—Carl D. Friedman*Assistant Examiner*—Yvonne Horton-Richardson*Attorney, Agent, or Firm*—Bacon & Thomas, PLLC[57] **ABSTRACT**

Floor covering, including hard floor panels (1) which, at least at the edges of two opposite sides (2-3, 26-27), are provided with coupling parts (4-5, 28-29), cooperating with each other, substantially in the form of a tongue (9-31) and a groove (10-32), wherein the coupling parts (4-5, 28-29) are provided with integrated mechanical locking elements (6) which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges (2-3, 26-27) and parallel to the underside (7) of the coupled floor panels (1).

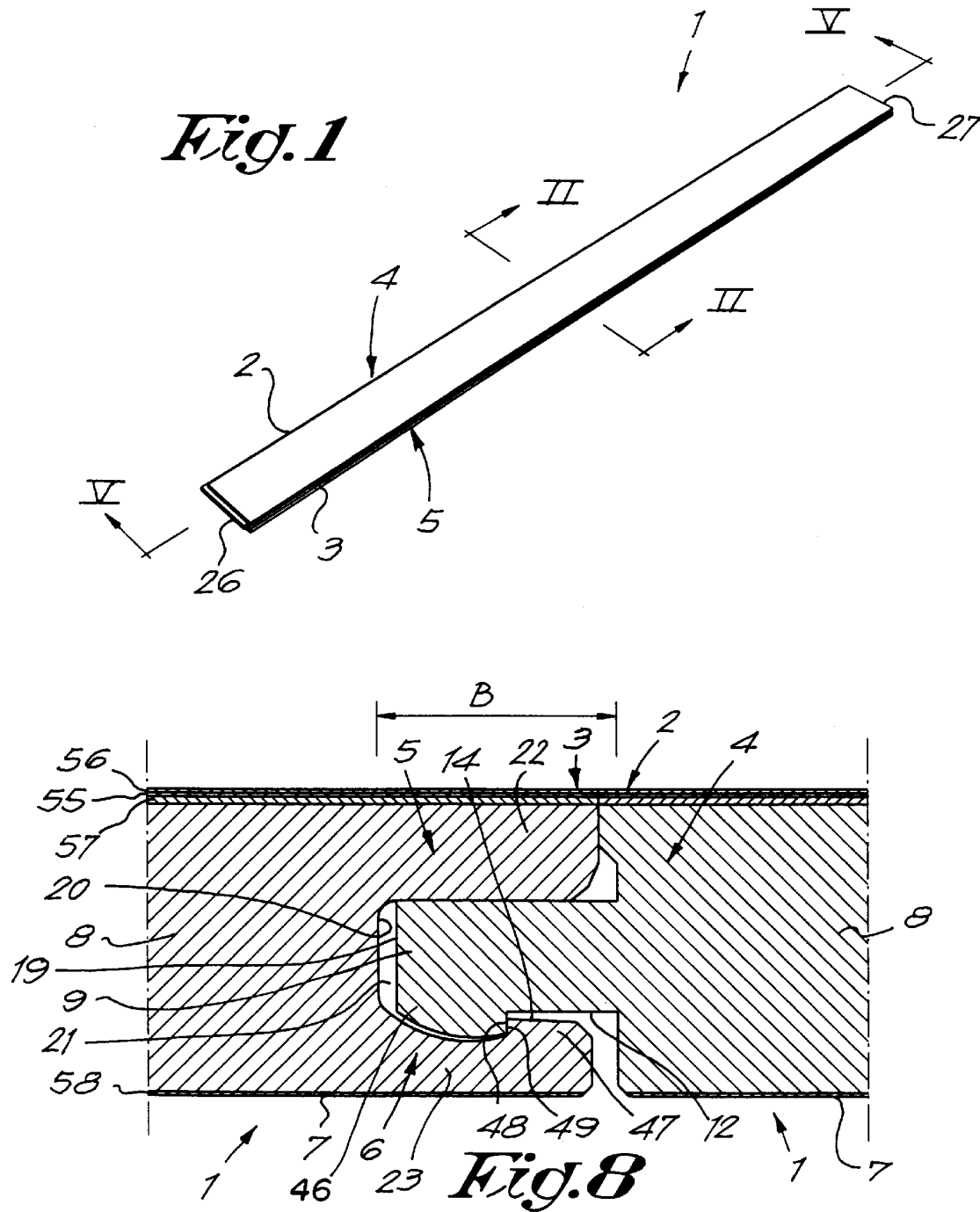
66 Claims, 10 Drawing Sheets

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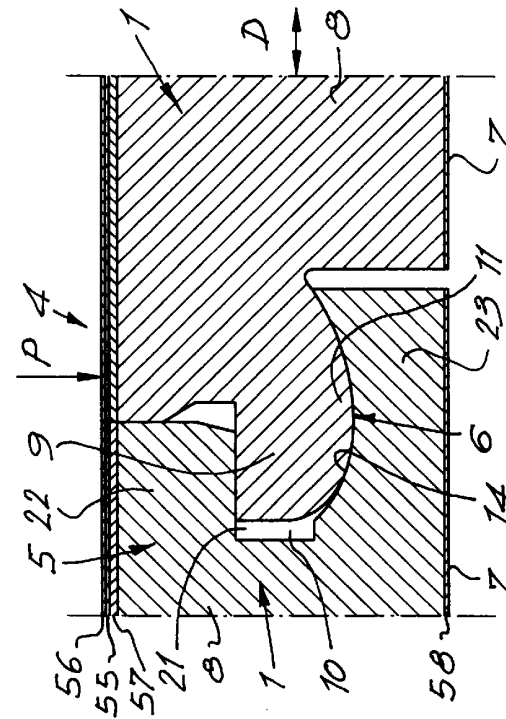
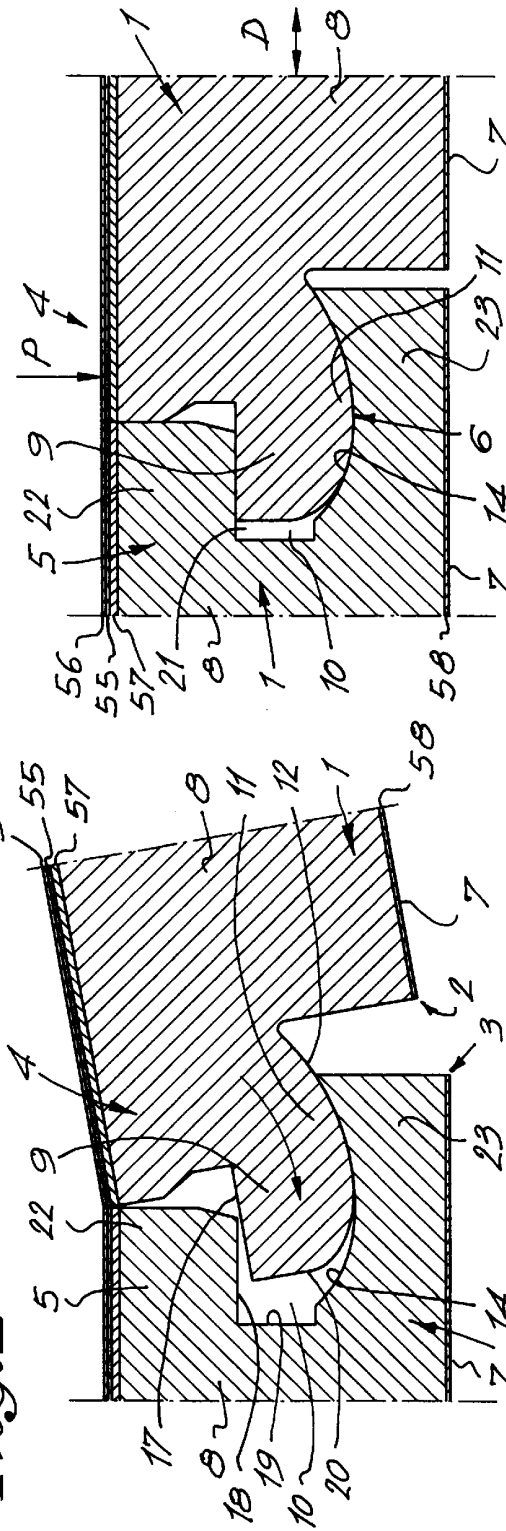
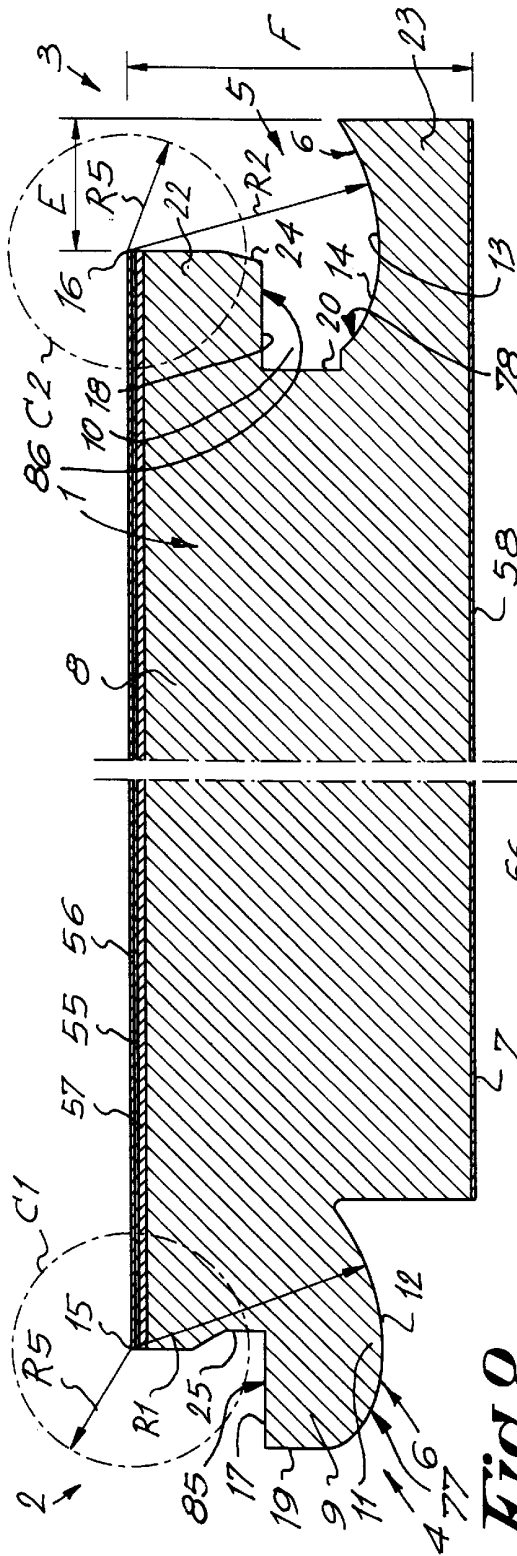


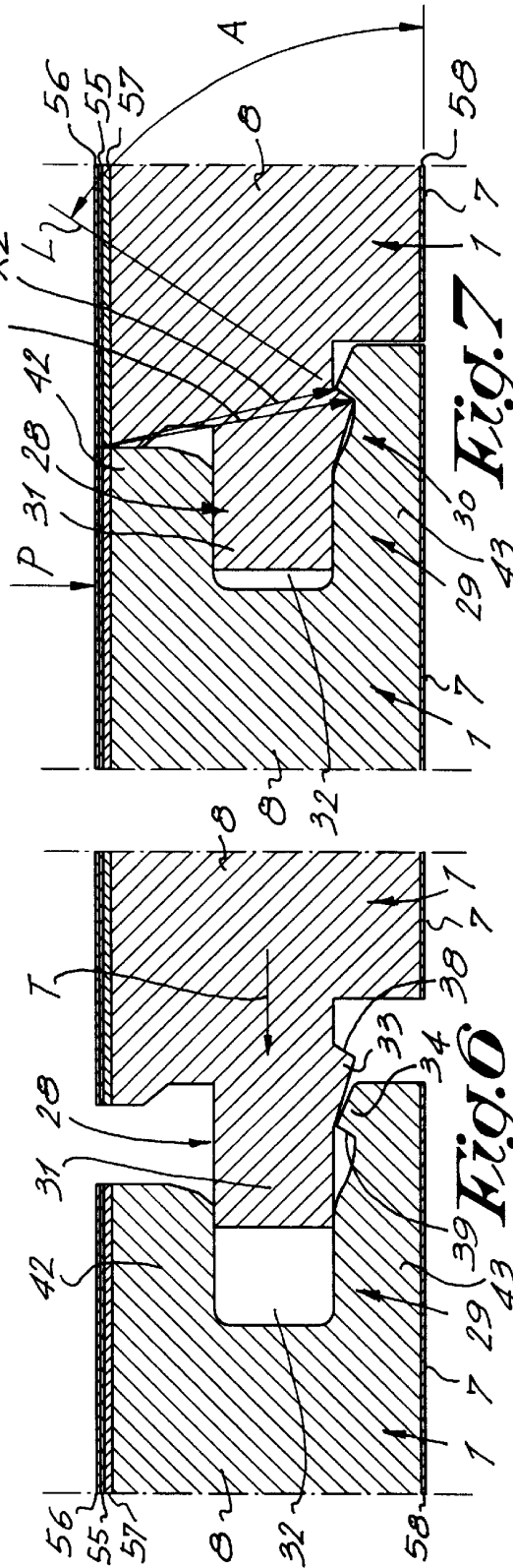
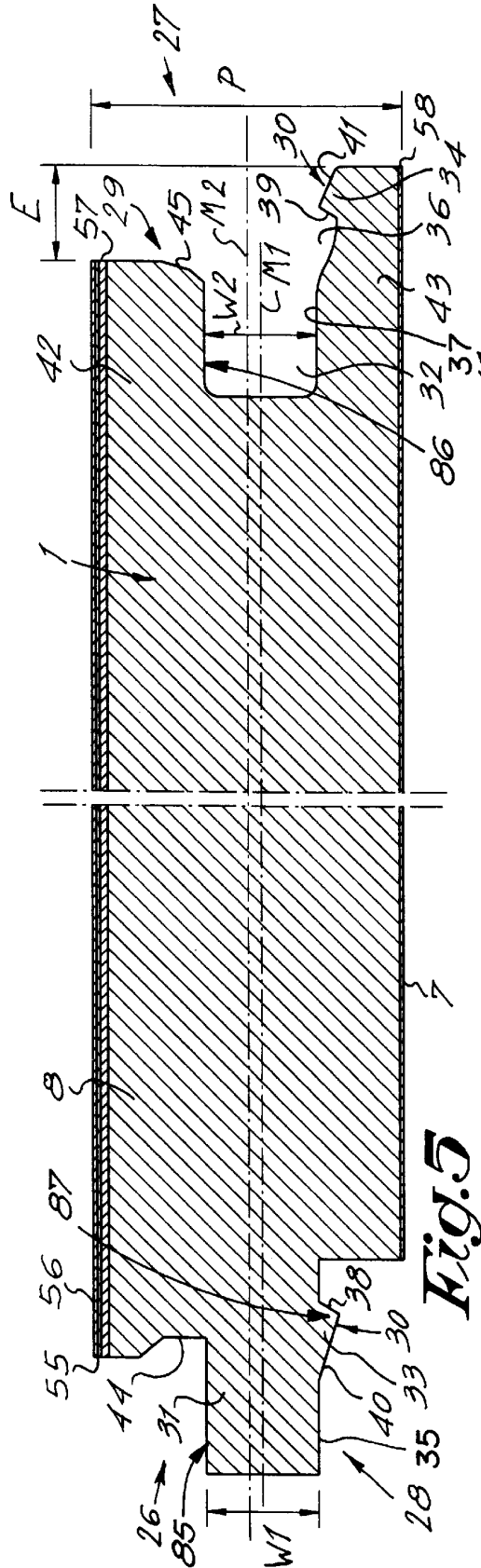
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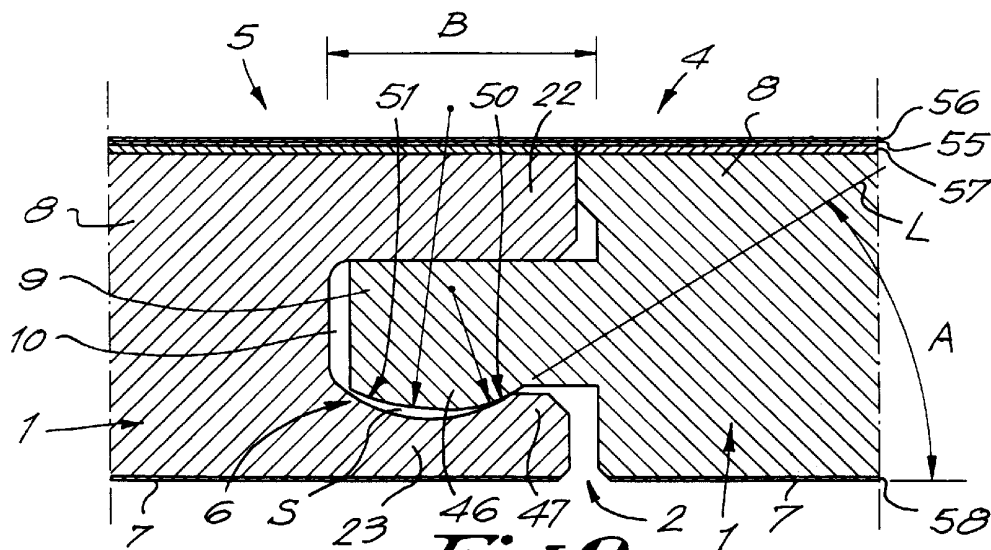


Fig. 9

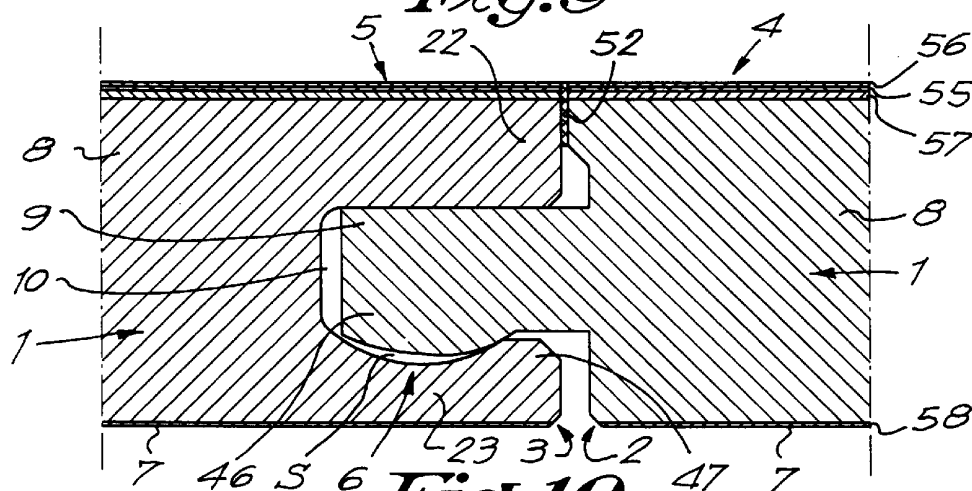


Fig. 10

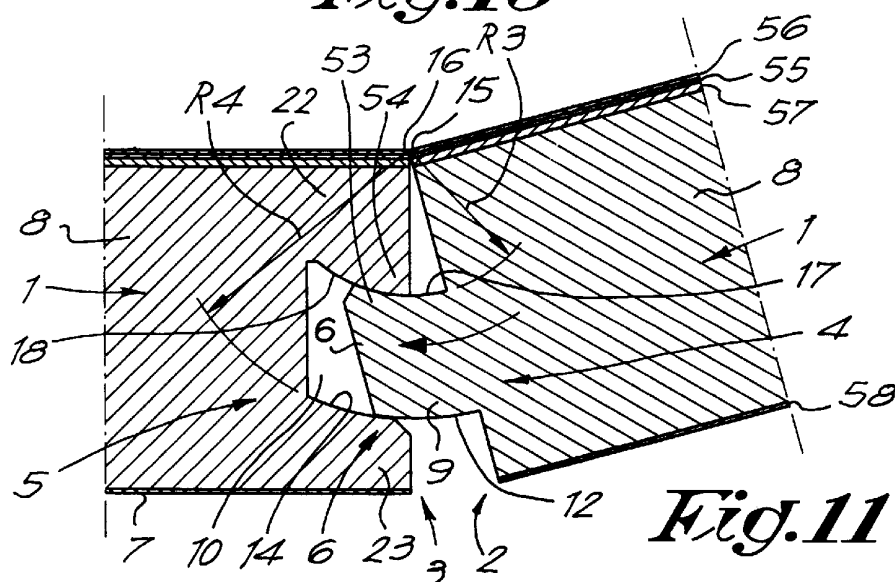


Fig. 11

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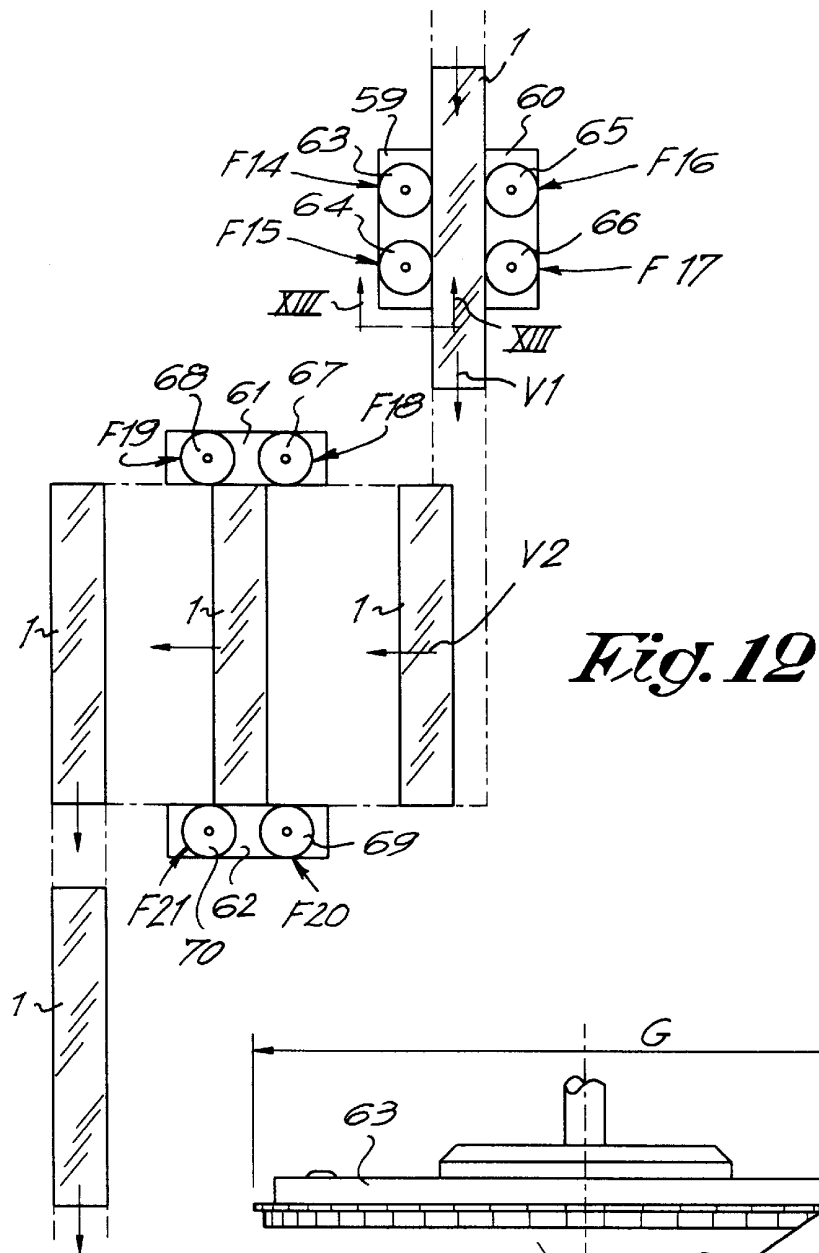


Fig. 12

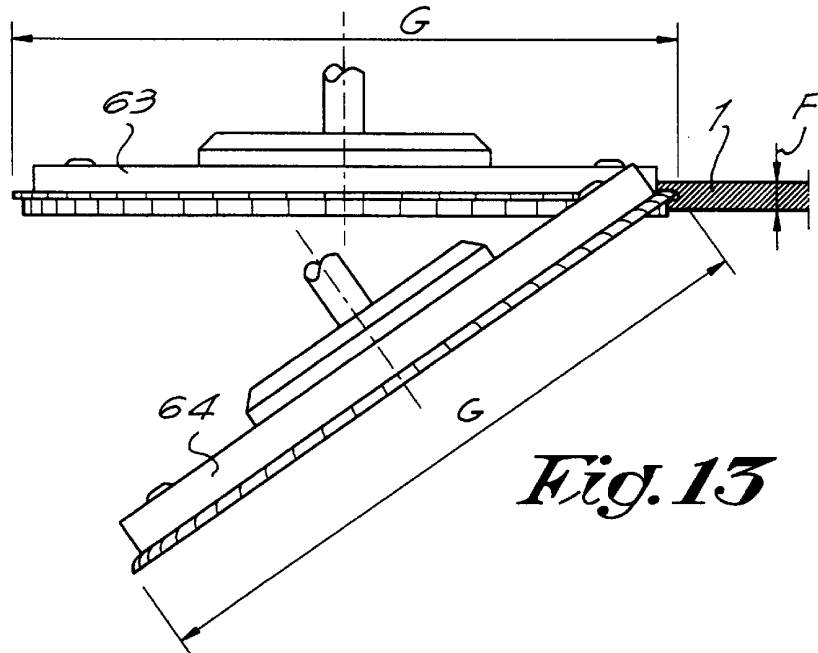


Fig. 13

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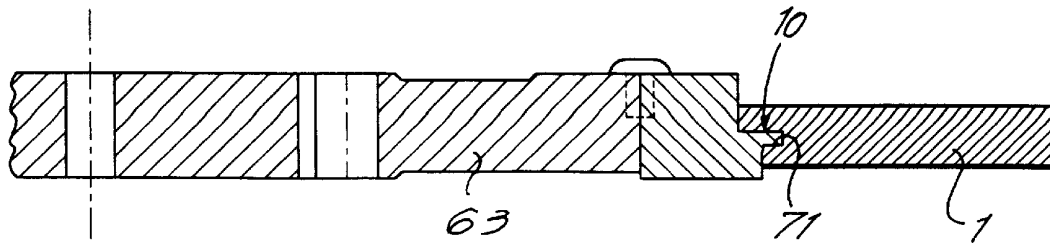


Fig. 14

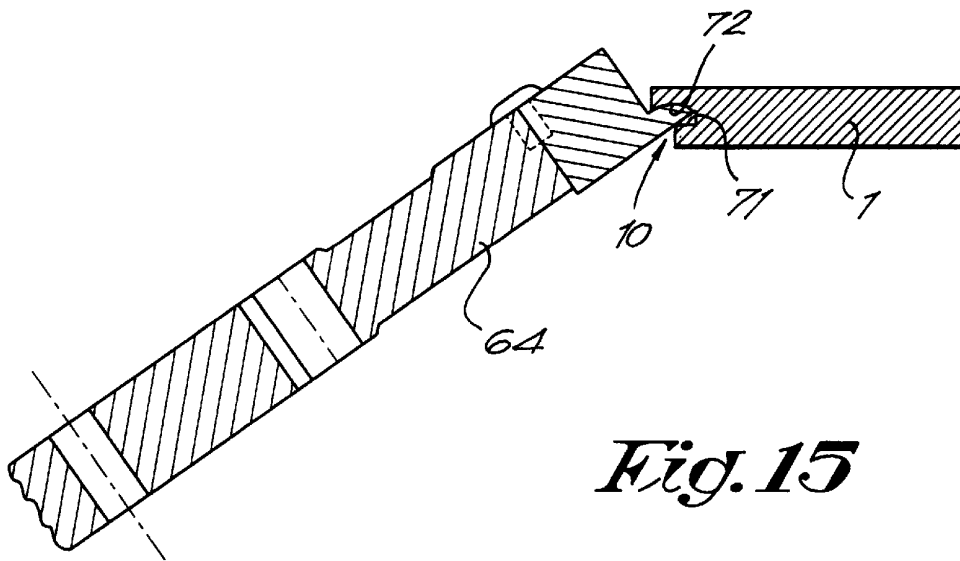


Fig. 15

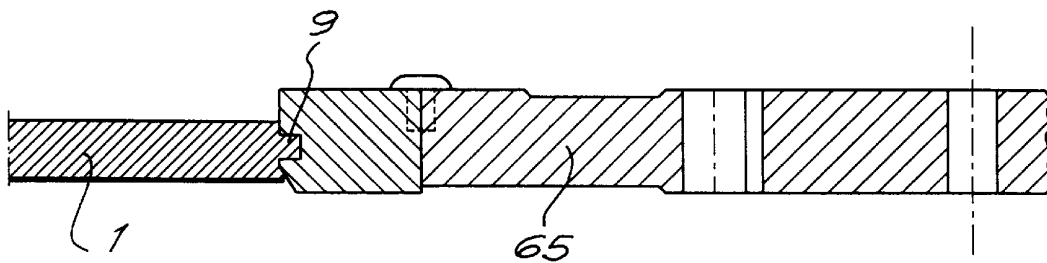


Fig. 16

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Fig. 17

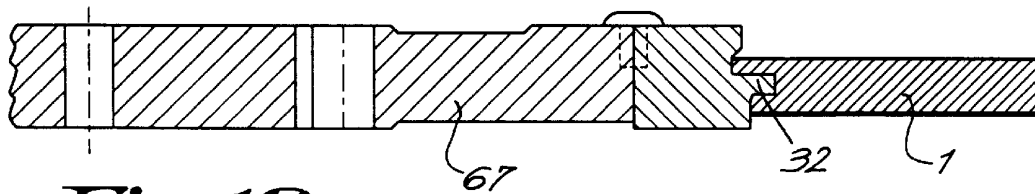
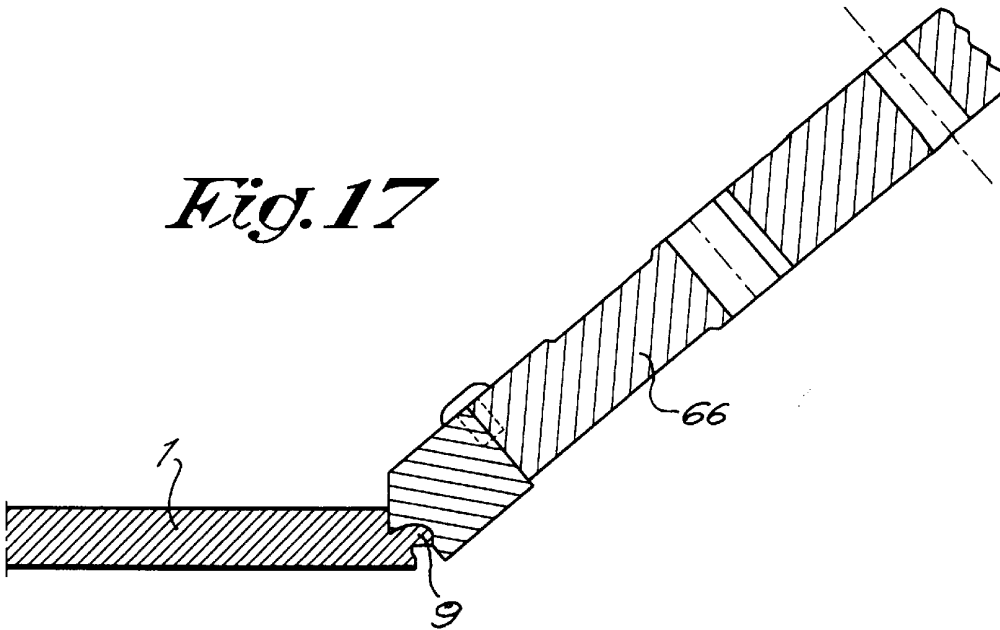


Fig. 18

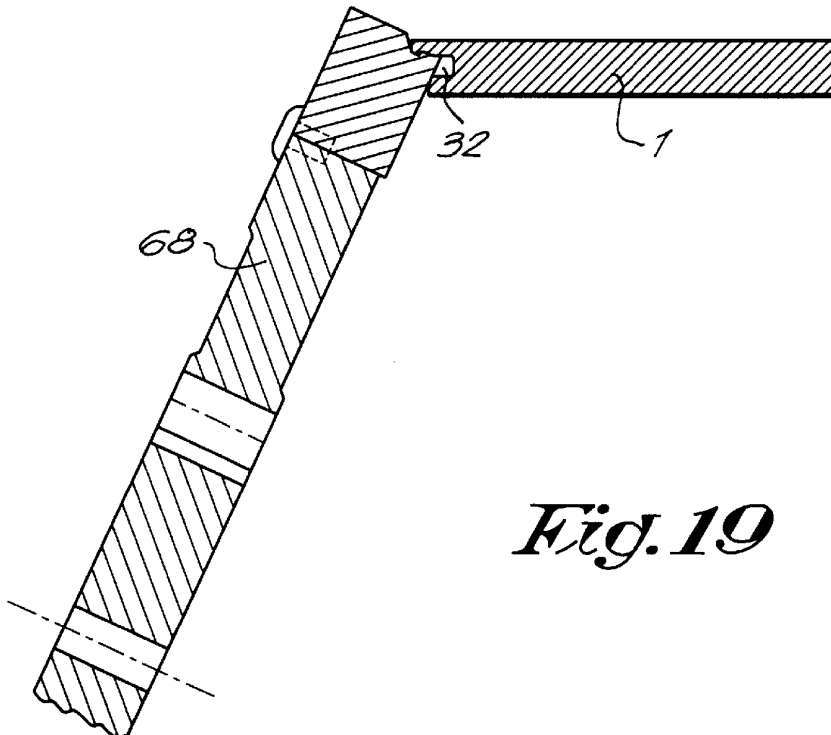


Fig. 19

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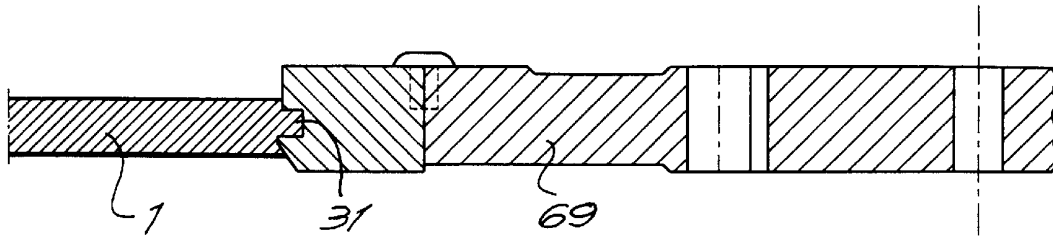


Fig. 20

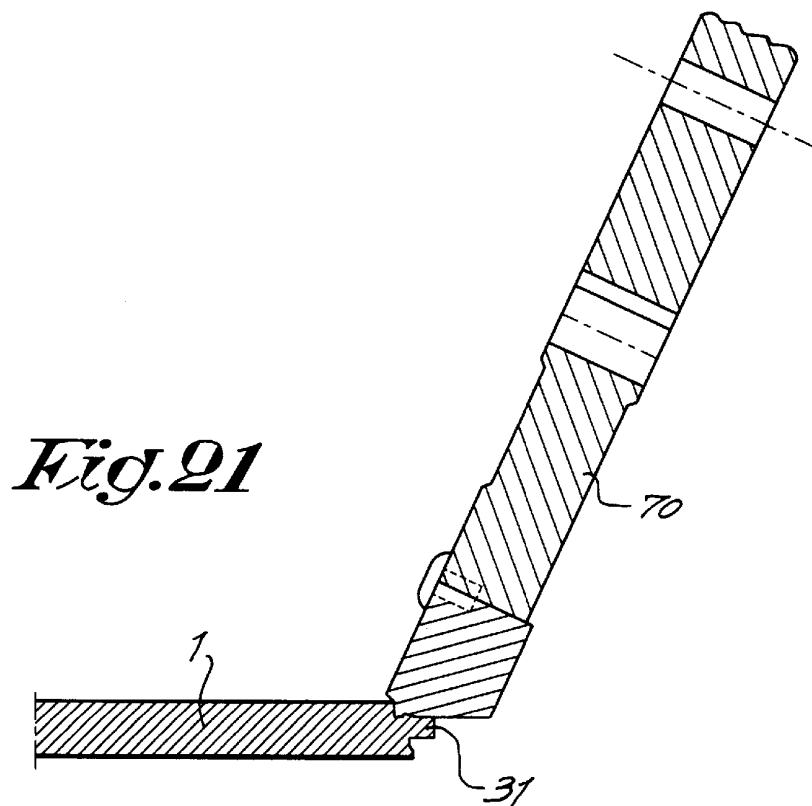


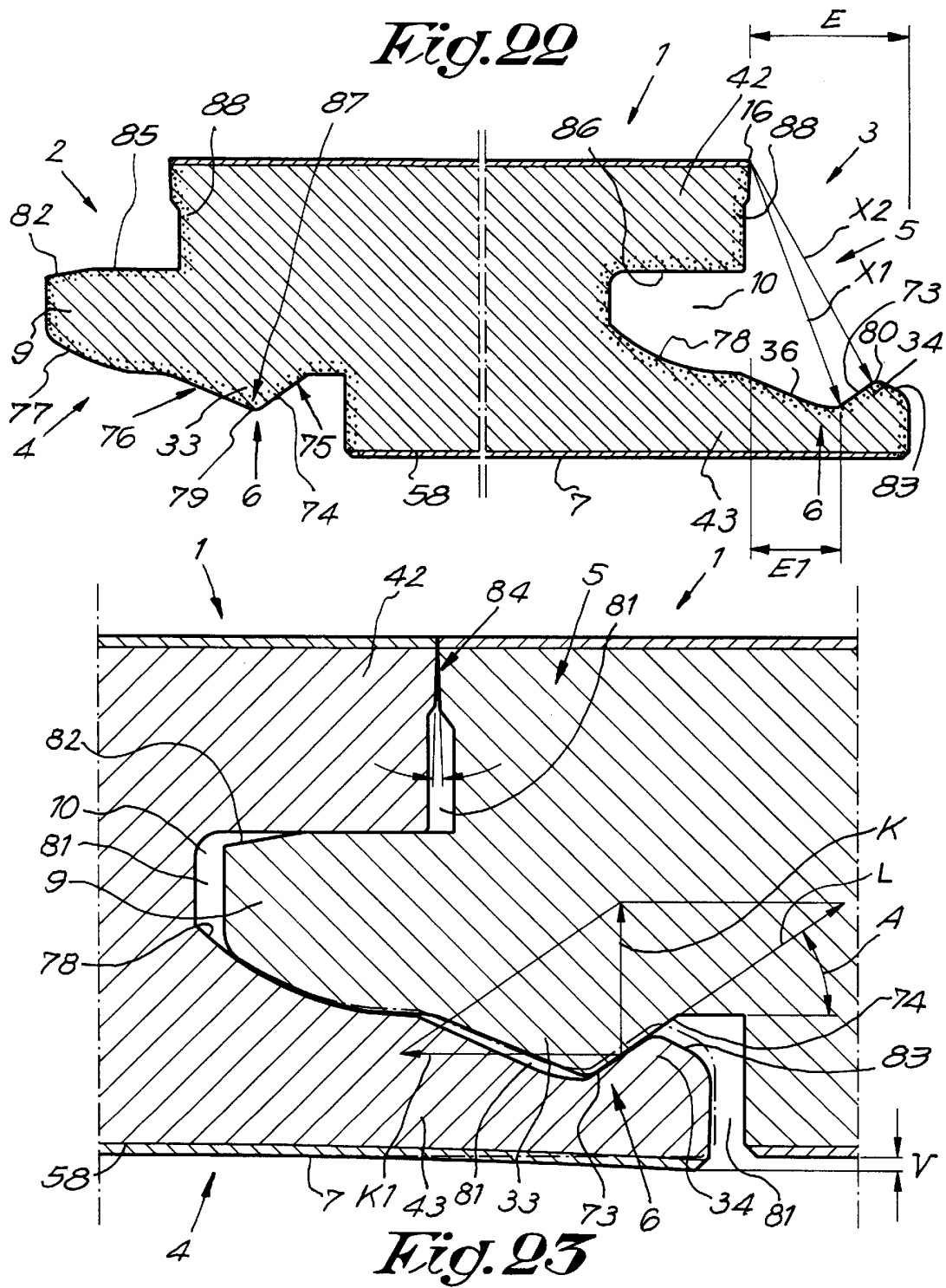
Fig. 21

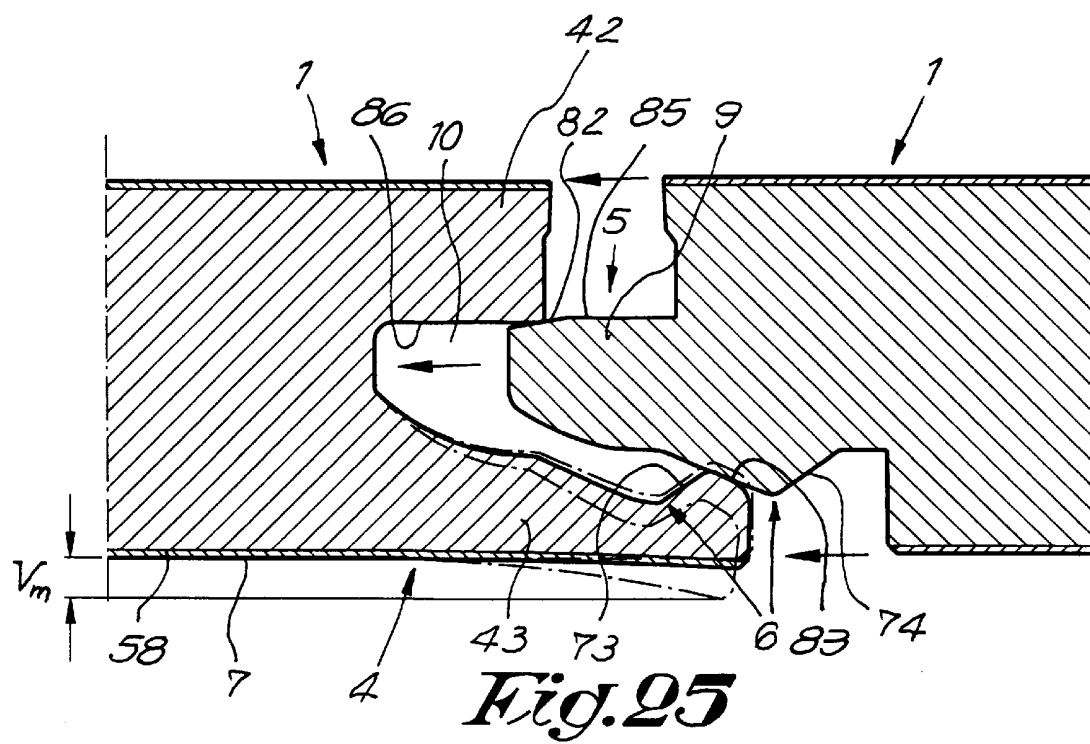
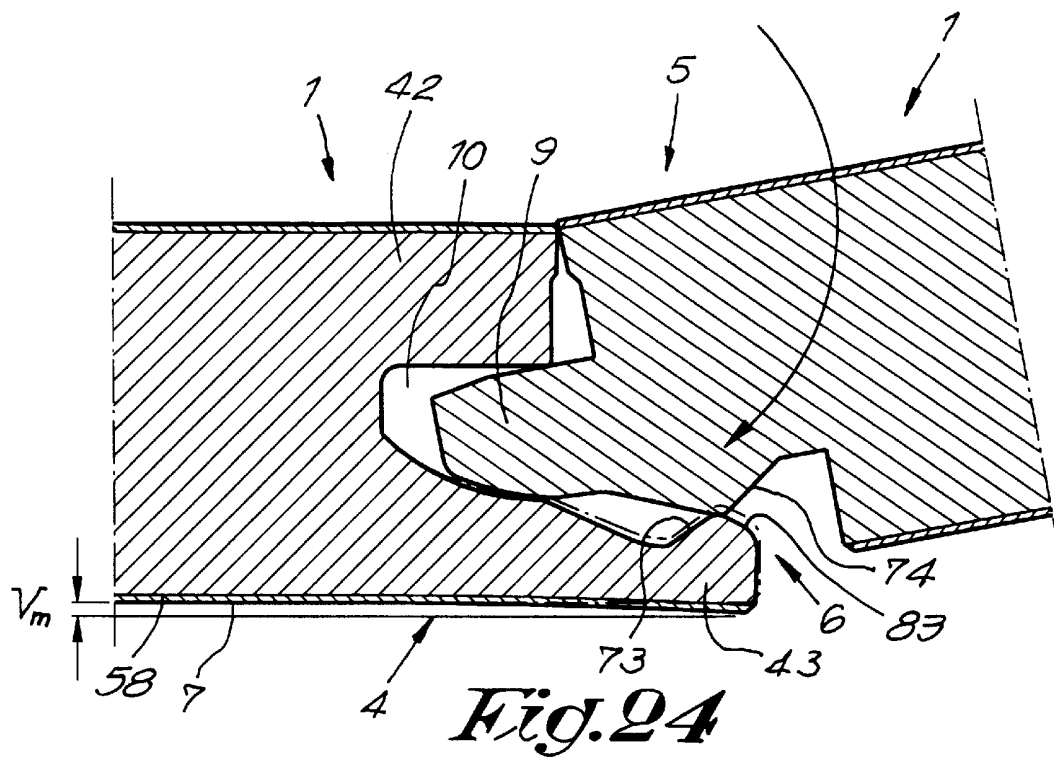
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FLOOR PANEL WITH EDGE CONNECTORS**BACKGROUND OF THE INVENTION****1. Field of the Invention**

This invention relates to a floor covering, made of hard floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be

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coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking means are formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection

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between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking means exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the con-

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nections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. 1 represents a floor panel of a floor covering according to the invention;

FIG. 2, on a larger scale, represents a cross-section according to line II—II in FIG. 1;

FIGS. 3 and 4 represent how two floor panels with coupling parts according to FIG. 2 match into each other;

FIG. 5, on a larger scale, represents a cross-section according to line V—V in FIG. 1;

FIGS. 6 and 7 represent how two floor panels with coupling parts according to FIG. 5 match into each other;

FIGS. 8 to 11 represent a number of variants of coupling parts of floor panels according to the invention;

FIG. 12 schematically represents how the floor parts can be provided with coupling parts;

FIG. 13 represents a cross-section according to line XIII—XIII in FIG. 12;

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FIGS. 14 to 21, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. 12 with arrows F14 to F21;

FIG. 22 represents a floor panel according to the invention;

FIG. 23, on a larger scale, represents the coupling of two floor panels of FIG. 22;

FIGS. 24 and 25 represent two manners of coupling floor panels according to FIG. 22 to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels 1, for example, such as a laminated panel as shown in FIG. 1.

These floor panels 1 can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. 1, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is, at least at the edges of two opposite sides 2-3, provided with coupling parts 4-5 which permit two adjacent identical floor panels 1 to be coupled to each other.

According to the invention, the coupling parts 4-5, as represented in the FIGS. 2 to 4, are provided with integrated mechanical locking parts or elements 6 which prevent the drifting or sliding apart of two coupled floor panels 1 in a direction D perpendicular to the respective sides 2-3 and parallel to the underside 7 of the coupled floor panels 1; the coupling parts 4-5 and the locking elements 6 are formed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two subsequent floor panels 1 can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel 1 can be laterally inserted into the previous; and the coupling parts 4-5 preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels 1 with an elongated shape, as represented in FIG. 1, the respective coupling parts 4-5 are located at the longitudinal sides 2-3.

The coupling parts 4-5 can be realized in various forms, although the basic forms thereof will always be formed by a tongue 9 and a groove 10.

In the form of embodiment of FIGS. 2 to 4, the related floor panel 1 is provided with coupling parts 4-5 and locking means 6 which allow two floor panels 1 to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements 9 consist of a first locking element 11, formed by a protrusion with a bent round shape at the lower side 12 of the tongue 9, and a second locking element 13, formed by a recess with a bent hollow or downwardly concave shape in the lower wall 14 of the groove 10.

The locking elements 11-13 ensure that two floor panels 1 which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels 1 to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side 12 of locking means

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6 has a curvature with a radius R1, the center of which coincides with the respective upper edge 15 of the floor panel 1, whereas the lower wall 14 of the locking part 5 has a curvature with a radius R2 which is equal to the radius R1, but its center coincides with the respective upper edge 16. Radii R1 and R2 may also be applied which are larger or smaller than the distance to the upper edge 15, 16 respectively, and/or which differ from each other in size.

The upper side 17 of the tongue 9 and the upper wall or side 18 of the groove 10 are preferably flat and preferably are located in the horizontal plane.

The front or inner end or sides 19 and 20 of the tongue 9 and the groove 10 of the two interlocked floor panels 1 preferably do not fit closely against each other, such that an intermediate space 12 is created between them into which possible dust remainders or such can be pushed away by means of the tongue 9.

The tongue 9 and the groove 10 preferably have shapes which are complementary to each other, such that the tongue 9 in the engaged condition of two identical floor panels 1 precisely sits against the upper wall 18 and the lower wall 14 of the groove 10, whereby a pressure P, exerted against the upper lip 22, is received or reacted not only by this lip 22, but by the complete structure, because this pressure can be transmitted through the tongue 9 and the lower lip 23 to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer 24 and lip 22 and a recess 25 can be provided, as represented in FIGS. 2 to 4, as a result of which the subsequent floor panels 1 can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. 5 to 7, the floor panels 1 according to the invention can also, along the sides 26-27 which are at a right angle to the sides 2-3, be provided with coupling parts 28-29 which have locking means 30, too. The coupling parts 28-29 are preferably also realized in the shape of a tongue 21 and a groove 32. Hereby, the locking elements 30 do not have to be of the same nature as the locking elements 6.

Preferably, at the sides 26-27 locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. 6 and 7. To this aim, the locking means 30 consist of a snap-together connection with locking elements 33 and 34 which grip behind each other.

As represented in FIGS. 5 to 7, the locking element 33 preferably consists of a protrusion of the lower side 35 of the tongue 31 which can be located in a recess 36 in a lower lip 43 extending distally from the lower wall 37 of the groove 32. The locking element 34 is formed by the upward directed part or protrusion which defines the distally outer end of recess 36.

In this case, the locking elements 33-34 have contact surfaces 38-39 which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces 38-39, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside 7, which angle is smaller than 90°.

The locking elements 33-34 preferably are provided with inclined portions 40 and 41 which, when two floor panels 1

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are engaged, cooperate with each other in such a manner that the locking elements **33-34** can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. **6** and **7**).

The thickness **W1** of the tongue **31** preferably is equal to the width **W2** of the groove **32**, such that compression pressure **P** applied to the upper lip **42** is reacted by the tongue **31** which, in its turn, then is reacted by the lower lip **43**.

Analogous to the chamfer **24** and recess **25**, a recess **44** and a chamfer **45** are provided also at the edges **28-29**.

It is noted that such a snap-together coupling can also be applied at the edges **2-3**. Hereby, this can be a snap-together coupling analogous to these of FIGS. **5** to **7**, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. **8** and **9**. Contrary to the locking elements **33-34** which consist of rather local protrusions, in the forms of embodiment of FIGS. **8** and **9** use is made of locking elements **46-47** which, in comparison to the total width **B** of the coupling, extend over a rather large distance.

In this case, the locking elements **46-47** are also provided at the lower side **12** of the tongue **9** and the lower wall **14** of the groove **10**.

According to FIG. **8**, the locking elements **46-47** have contact surfaces **48-49** which are at an angle with the plane of the floor panel **1**. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. **9**, the locking elements **46-47** possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements **46-47** hereby consist of curved surfaces. The common plane of tangency **L** forms an angle **A** which is smaller than 90° , and more preferably is smaller than 70° .

In this manner, the locking element **46** preferably has two portions with a different curvature, on one hand, a portion **50** with a strong curvature and, on the other hand, a portion **51** with a weak curvature. The portion **50** with the strong curvature provides for the formation of a firm coupling. The portion **51** with the weak curvature facilitates the coupling parts **4-5** to be brought into each other easily. The intermediate space **S** forms a chamber which offers space for dust and the like which, when engaging two floor panes **1**, inevitably infiltrates there.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. **7** to **9**, preferably the tongue **9-31** has a shape that thickens from below, which then can cooperate with a widened portion in the groove **10**.

In FIG. **10**, a variant is represented whereby at least at the level of the upper edges **15-16**, a sealing material **52** is provided, as a result of which a watertight sealing can be assured. This sealing material **52** may consist of a strip or covering which is provided previously at the floor panel **1**, either at one or both upperside edges **15-16**.

In FIG. **11**, a further variant is represented, whereby the locking element **6** is formed by an upward directed portion **53** at the tongue **9**, which as a result of a turning movement of the panel, is brought behind a downward-directed portion **54** on the upper wall **18**. More particularly, this is obtained by forming the upper side **17** and the upper wall **18** with a curvature **R3**, the center of which is situated at the upperside edges **15-16**, and forming the lower side **12** and the lower

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wall **14** with a radius **R4**, the center of which is also situated at the upperside edges **15** and **16**, respectively. These radii **R3-R4** can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius **R1**, **R3** respectively, and, on the other hand, the radius **R2**, **R4** respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle **C1**, **C2** (see FIG. **2**) respectively, which extends with a radius **R5** of 3 mm centered at upperside edge **15**, **16** respectively.

Finally is noted that, according to the invention, the lower lip **23-43**, as represented in FIGS. **2** to **7**, can be formed distally longer than the upper lip **22-42**. This has an advantage that the coupling parts **4-5-28-29** can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels **1**, because each subsequent floor panel **1** during installation can be placed upon the protruding lower lip **23-43**, as a result of which the tongue **9-31** and the groove **10-32** automatically are positioned in front of each other.

The embodiments wherein the lower lip **23** is equal to or distally shorter than the upper lip **22**, in their turn, offer the advantage that no protruding lip **23** remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference **E** between the distally outer edge of the upper lip **22-42** and the distally outer edge of the lower lip **23-43**, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove **10**, should preferably be kept smaller than one time the total thickness **F** of the floor panel **1**. For stability's sake, normally this total thickness **F** shall never be less than 5 mm.

The small dimension of the difference **E** offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line **M1** through the tongue **9** and the groove **10** is situated lower than the center **M2** of the floor panel **1**, such, that the upper lip **22-42** is thicker than the lower lip **23-43**. In first instance, this is essential in this kind of connection, because then it is the lower lip **23-43** which bends, whereby the upper side of the floor panel **1** is kept free of possible deformations.

As explained in the introduction, for the core **8** a material is chosen from the following series:

- a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;
- a product based on synthetic material;
- chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. **2** to **11**, such laminated flooring preferably consists of a core **8** made of MDF medium density fiberboard board, HDF high density fiberboard board or similar, whereby at least at the upper side of this core **8** one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer **55** and a protective top layer **56**. The decorative layer **55** is a layer, impregnated

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with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer **56** preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer **57** upon which the decorative layer **55** is provided.

Preferably, also a backing layer **58** shall be applied at the underside **7**, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel **1**. This backing layer **58** may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. **12**, the tongue **9** and the groove **10**, and preferably also the tongue **31** and the groove **32** are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels **1** preferably shall be displaced by means of two sequential perpendicular movements **V1** and **V2**, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices **59-60**, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices **61-62**. During these processing, the floor panels **1** preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue **9-31** and groove **10-32** are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel **1**.

This is illustrated in FIGS. **13**, **14** and **15**, wherein it is represented how a groove **10** is realized by means of two milling cycles by means of two milling cutters **63** and **64**. FIGS. **16** and **17** represent how the tongue **9** is shaped by means of milling cutters **65** and **66**.

The FIGS. **18-19** and **20-21** represent similar views showing how the groove **32** and the tongue **31** are shaped by means of milling cutters **67-68** and **69-70**, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter **63** of FIG. **14** determines the final shape of the lower flank **71** of the groove **10**, whereas the milling cutter **64** determines the final shape of the upper flank **72**.

As mentioned in the introduction, preferably milling cutters **63** to **72** shall be used, having diameters **G** which are at least 5 times, and even better at least 20 times larger than the thickness **F** of the floor panels **1**.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first pre-machining cycle.

In the FIGS. **22** to **25**, a particularly preferred form of embodiment of a floor panel **1** according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

An important characteristic herein consists in that the coupling parts **4-5** are provided with locking elements **6** which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor portions **1** are forced towards each

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other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip **43**, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels **1** being forced towards each other. The resultant bending **V**, as well as the tension force **K**, are indicated in the enlargement view of FIG. **23**.

In order to obtain the tension force **K** pressing together the engaged floor panels **1**, the bendable portion, in this case the lip **43**, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface **73** which preferably can cooperate with a corresponding contact surface **74** on tongue **9**. These contact surfaces **73-74** are similar to the aforementioned contact surfaces **39-38** and also similar to the inclined portions of the lower lip of FIGS. **2** to **4**.

In the FIGS. **2** and **5**, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. **23** can be realized.

Due to, on one hand, the contact along the angle **A**, and, on the other hand, the fact that a tension force **K** is created, a compression force component **K1** is produced, as a result of which the floor panels **1** are drawn against each other in compression.

Preferably, the angle **A** of the mutual plane of tangency of contact surfaces **73-74** relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force **K** is realized, an angle **A** of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels **1** and, on the other hand, to ensure that the floor panels **1** can easily be engaged and respectively disassembled.

Although the pressing force **K1** preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending **V** is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon and underlaid which is elastically compressible, as a result of which the bending **V** of the lip **43** only produces local bending of the underlaid.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4-5**, including the locking elements **33-34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

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A further particular characteristic of the embodiment of FIGS. 22 to 25 consists in that the floor panels 1 can be selectively engaged by means of a turning movement, as represented in FIG. 24, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. 25, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending Vm results in the coupling parts, more particularly in the lip 43, which bending Vm is less pronounced, if not nonexistent, as in the FIGS. 2 to 4, in comparison to the bending Vm which results when the floor panels 1 are engaged by means of shifting them towards each other.

The advantage of this consists in that the floor panels 1 can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel 1 can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts 4-5 shown in FIGS. 22 to 25 can also be used for the coupling parts 28-29 of the short sides of the panels.

According to the invention, in the case that the four sides 2-3-26-27 are provided with coupling parts 4-5-28-29, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels 1, for example, such as represented in FIG. 1, the locking at the small sides 26-27 preferably shall be more pronounced than at the longitudinal sides 2-3. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces 73-74 with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element 33, is bounded by at least two portions 75-76, respectively a portion 75 with a strong (steep) inclination which provides for the locking, and a portion 76 with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. 22 to 25, these portions 75-76 are formed by straight planes, but, as already described with reference to FIG. 9, use can also be made of curved portions 50-51. In FIG. 5, these are the contact surface 38 and the inclined portion 40.

In the preferred form of the invention, the floor panels 1 comprise coupling parts 4-5 and/or 28-29 exhibiting one of the following or the combination of two or more of the following features:

- a curvature 77 at the lower side of the tongue 9 and/or a curvature 78 at the lower lip 43 which form a guidance when turning two floor panels 1 into each other, with the advantage that the floor panels 1 can be engaged into each other easily during installation;

- roundings 79-80 at the edges of the locking elements 33-34, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels 1 and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;

- dust chambers 81, or spaces 21 as in FIG. 4, between all sides, directed laterally towards each other, of the

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engaged floor panels 1, with the advantage that inclusions which get between the floor panels 1 during the engagement do not exert an adverse influence upon good engagement;

- a shaping of the tongue 9 which is such, for example, by the presence of a chamfer 82, that the upper side of the tongue 9 becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip 42 when the floor panels 1 are pushed towards each other in substantially the same plane, as indicated in FIG. 25, with the advantage that the front extremity or end of the tongue 9 does not press against the front side of the upper lip 42 or the front edge of the bottom lip 43 when the floor panels are pushed towards each other in the same plane;

- a ramp surface 83, hereinbefore also called inclined portion 41, formed at the distally outer end of the lower lip 43, with the advantage that the locking elements 33-34 shift smoothly over each other and that the lower lip 43 is bent uniformly;

- in the engagement direction only one important contact point which is formed by a section 84 at the location of the upperside edges of the floor panels 1, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels 1 and that the development of openings between the floor panels 1 is counteracted;

- contact surfaces 85-86, more particularly abutment surfaces, formed by the upper side of the tongue 9 and the upper side of the groove 10 which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels 1, as well as contact surfaces cooperating with each other, formed by curvatures 77-78, with the advantage that no mutual displacement in height between two engaged floor panels 1 is possible, even if the insertion depth of the tongue 9 into the groove 10 should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. 22 to 25, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. 2 to 11, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. 5 to 7 and 22 to 25, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element 6, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip 23-43 which extends beyond the distal edge of the upper lip 22-42, more particularly, the lowermost point 87 of the locking part 33 is situated under the top layer of the floor panel 1. For clarity's sake, this top layer is indicated in the FIGS. 22-25 only as a single layer.

It should be noted that the combination of features, the lower lip 23-43 extending further than the upper lip 22-42; the locking means 6 being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip 23-43 which extends distally beyond the upper lip 22-42, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels 1 can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip 23-43

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adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface **39** or **73**, preferably extends in such a manner that the distance between the upper edge **16** of the panel to the contact surface **39** diminishes between the proximal and distal ends of the sloping contact surface **39**, in other words, such that, as represented in FIG. **22**, the distance **X2** is smaller than the distance **X1**. This is also the case in FIG. **7**.

Still preferably, this portion only starts at a clear distance **E1** from the outer edge of upper lip **42**.

It is obvious that the coupling parts **22** to **25** can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels **1** are treated at their sides **2-3** and/or **26-27** with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. **22**, such impregnation **88** is represented schematically. This treatment can be performed over the complete surface of the sides **2-3** and/or **26-27** or only over specific portions hereof, for example exclusively on the surfaces of the tongue **9** and the groove **10**.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts **4-5** and/or **28-29** better keep their shape and strength, even if the floor panels **1** are engaged and disassembled repeatedly. In particular, if the core **8** is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, can such floor covering and the pertaining floor panels **1** be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

We claim:

1. A floor covering laminated panel comprising a wood product containing composite core and an upper decorative surface, said panel having an upper side terminating at opposed upper side edges, an underside extending parallel to the upper side, and side edges terminating at said upper side edges at their upper ends and provided with coupling parts integrally formed in one piece with said core, said coupling parts configured to cooperate by coupling with cooperative coupling parts of an identical one of said panel; said coupling parts comprising a tongue and a groove configured to lock together coupled identical ones of said panel in a direction perpendicular to the plane of the coupled panels when cooperative coupling parts of the panels are engaged, said groove and tongue having respective upper and lower sides, and wherein the panel side edge provided with the groove has an upper lip located above and adjacent the upper

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side of the groove, and terminating at a distal upper lip edge, and a lower lip extending distally beyond said distal upper lip edge in the plane of the panel; said coupling parts including locking elements formed integrally in one piece with said core, said locking elements including cooperative contact surfaces arranged to be engaged when adjacent identical ones of said panel are coupled together with their coupling parts cooperatively engaged to prevent substantial separation of two coupled identical ones of said floor panels at said upper side edges in a direction perpendicular to the edges of the panel sides and parallel to the undersides of the coupled floor panels; said locking means comprising a locking element in the form of a downwardly extending protrusion located on the lower side of the tongue and an upwardly facing cooperating locking recess in the lower lip, said locking recess being located at a position that is at least partially distally beyond a distal edge at which the upper lip terminates, said cooperative contact surfaces defined respectively by said protrusion and said recess, and configured, when engaged in a cooperative relationship upon coupling in a common plane of two identical ones of said panel, to meet each other at a common plane of tangency that with respect to the lower lip is inclined at an angle other than 90° relative to the common plane of the coupled panels, said angle extending inwardly and downward from a distally outer location to a proximal inner location.

2. A floor covering panel according to claim **1**, wherein the material of the core, including the locking elements, is constituted of a wood product material consisting of a ground product which, by means of a binding agent, is formed into a unitary composite material.

3. A floor covering panel according to claim **2**, wherein the material of the core of the floor panel comprises fiberboard selected from the group consisting of high density fiberboard and medium density fiberboard.

4. A floor covering panel according to claim **2**, wherein the material of the core of the floor panel consists of a chip board with fine chips bound together.

5. A floor covering panel according to claim **1**, wherein the locking surface defined by the tongue extends downwardly from the lower side of the tongue at an inclination that extends outwardly and downwardly from a proximally inner location to a distally outer location.

6. A floor covering panel according to claim **1**, wherein both of said cooperating contact surfaces are inclined relative to the panel underside.

7. A floor covering panel according to claim **6**, wherein both contact surfaces are inclined in a generally parallel directions, so that they will at least partially abut each other when cooperative coupling parts of said locking means are coupled together with said contact surfaces located contiguous with each other.

8. A floor covering panel according to claim **1**, wherein the contact surface defined by said recess extends inwardly and downwardly from a distal location to a proximal location relative to the panel underside.

9. A floor covering panel according to claim **8**, wherein said contact surface is substantially flat.

10. A floor covering panel according to claim **1**, wherein said protrusion has a base extending over a substantial width of the lower side of the tongue.

11. A floor covering panel according to claim **1**, wherein said recess is distally spaced from said distal upper lip edge.

12. A floor covering panel according to claim **1**, wherein said lower lip has an upper side, and wherein the groove lower side extends continuously with the upper side of said lower lip, and an inner end of the groove lower side is

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located inwardly of the distal upper lip edge, and wherein the lower lip increases in thickness progressively from the inner end of the recess to where it intersects the lower side of the groove, and the lower side of the groove increases in thickness from where it intersects the lip upper side to its proximal inner end.

13. A floor covering panel according to claim 12, wherein the lower lip includes a distal outer end, said distal outer end located distally from the locking recess, said outer end having a maximum thickness measured from the underside of the panel which is smaller than the smallest thickness of the lower side of the groove measured from the underside of the panel.

14. A floor covering panel according to claim 8 wherein the tongue and groove have a shape such that in coupled condition of two identical ones of said floor panel there is provided a chamber defined by a space between a lower surface of the downwardly extending protrusion and an adjacent upper surface of the recess, said chamber being located on the side of said protrusion which is located opposite a side thereof defining one of said contact surfaces.

15. A floor covering panel according to claim 1, wherein the coupling parts are dimensioned to provide a coupling free from play in all panel separation directions in a plane extending perpendicular to the said side edges when two identical ones of said panel are coupled together.

16. A floor covering panel according to claim 1, wherein the locking elements are configured such that when identical ones of said panel are coupled together, upon exertion of a pressure on top of one of the coupled panels which is provided with the tongue adjacent the upper side edge thereof, said locking elements react to the pressure to press the adjacent upper side edges of the coupled panels towards each other.

17. A floor covering panel according to claims 3, wherein a space is provided between the underside of said protrusion and an opposed adjacent surface of said lower lip when identical ones of said panel are coupled together.

18. A floor covering panel according to claim 1, wherein at least the contact surface defined by the recess comprises an inclined surface terminating at a distally outer rounded edge.

19. A floor covering panel according to claim 1, wherein said locking elements are configured and dimensioned such that when two identical ones of said panels are coupled in the same plane with their adjacent upper side edges abutting each other, said floor panels exert a tension force upon each other tending to urge the upper side edges towards each other.

20. A floor covering panel according to claim 19, wherein at least one of the coupling parts comprises an elastically yieldable portion which, when two identical ones of said panel are coupled, is at least partially bent within its elastic yield range to produce said tension force.

21. A floor covering panel according to claim 20, wherein the elastically yieldable portion comprises at least said lower lip at an area thereof located on the proximal side of the contact surface portion, and wherein said lower lip is constituted solely of said laminated panel material.

22. A floor covering panel according to claim 21, wherein the elastically yieldable portion includes the lower side of the groove.

23. A floor covering panel according to claim 1, wherein the coupling parts are configured such that two identical ones of said floor panel can be selectively coupled either by laterally sliding and snapping the cooperative coupling parts together or by turning one panel relative to the other with

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their cooperative coupling parts partially engaged, whereby additional ones of said floor panel can be sequentially coupled to previously coupled ones of said floor panel by laterally sliding each additional panel into a previously coupled panel, or by relative turning motions of an additional panel relative to a coupled panel.

24. A floor covering panel according to claim 1, wherein the panel has a total thickness between its upper side and its under side, and the distance between the upper side edge of the panel edge including the lower lip and the distal end of the lower lip measured in the plane of the floor panel is smaller than the total thickness of the floor panel.

25. A floor covering panel according to claim 1, wherein the total thickness of the floor panel is approximately 0.5 to 0.8 mm.

26. A floor covering panel according to claim 25, wherein the total thickness of the floor panel is at least 5 mm.

27. A floor covering panel according to claim 1, wherein the floor panel is elongated with said opposed pair of side edges located along its longer sides, and wherein said coupling parts extend along said side edges.

28. A floor covering panel according to claim 1, wherein the floor panel includes two opposed pairs of side edges, and said coupling parts extend in cooperative pairs along all four side edges.

29. A floor covering panel according to claim 28, wherein the cooperative coupling parts of at least two opposed edges are configured and dimensioned such that identical ones of said floor panel can be selectively coupled either by shifting them laterally towards each other approximately in a plane including the panels to engage their coupling parts or by a relative turning movement between the panels with the coupling parts partially engaged.

30. A floor covering panel according to claim 1, wherein a lower side of said protrusion is bordered by at least two portions, including a first portion having a first sloped inclination relative to the panel underside that defines said contact surface, and a second portion having a second sloped inclination relative to the panel underside that is less than the first sloped inclination and which guides the engagement of the coupling parts.

31. A floor covering panel according to claim 1, wherein the locking elements are snap type elements that are configured so as to snap together when cooperative locking elements of two identical ones of said panel are coupled together.

32. A floor covering panel according to claim 1, wherein said common plane of tangency is inclined at an angle of 30 to 70 degrees relative to said common plane.

33. A floor covering panel according to claim 1, wherein the lower side of the tongue is downwardly convexly curved.

34. A floor covering according to claim 33, wherein said convexly curved tongue lower side extends along substantially the complete length of a portion of the tongue located in a complementary groove when identical ones of said panel are coupled with a tongue of one panel located in a complementary groove of an adjacent panel.

35. A floor covering panel according to claim 34 wherein said convexly curved lower side of the tongue is configured and dimensioned such that the tongue is freely insertable into a complementary groove of another panel identical to said panel by turning one panel relative to the other about the upper edge of the panel in which the groove is located and while the cooperative coupling parts are partially engaged.

36. A floor covering panel according to claim 1, wherein an upper surface of the lower lip is curved and is configured to define a guidance surface for guiding the coupling parts

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of the panels into engagement with each other when said two identical ones of said floor panel are rotated relative to each other with their coupling parts partially engaged.

37. A floor covering according to claim 1, wherein when two identical ones of said panel are coupled together with their cooperative locking surfaces coupled together, spaces defining dust chambers are provided between substantially all laterally opposed sides of the coupled floor panels.

38. A floor covering panel according to claim 1, wherein the configuration of the tongue and the lower lip are such that a tongue of said panel may be lodged in the groove of another identical one of said panels by laterally moving the panels towards each other in approximately a plane including the panels starting from positions at which the panels are completely separated from each other.

39. A floor covering panel according to claim 38, wherein the upper side of the groove of one panel below the upper lip and the upper side of the tongue of the other panel are arranged and configured such that the tongue is guided towards cooperative engagement with the groove when the panels are moved laterally towards each other and approximately upon first contact between the panels.

40. A floor covering panel according to claim 1, wherein the distal end of the lower lip is provided with a sloped ramp surface, said ramp surface configured such that when the tongue of said panel is moved laterally towards the groove of the another identical panel approximately in a plane including the panels to cause engagement of cooperative coupling parts of the panels, the protrusion of said tongue is guided over the distal outer end of the lower lip by said ramp as the tongue traverses said distal outer end of the lower lip.

41. A floor covering panel according to claim 1, wherein apart from said contact surfaces, a contact point resisting mutual panel motion towards each other in a direction perpendicular to the panel side edges occurs between two coupled identical ones of said panel when two such panels are coupled with their cooperative contact surfaces engaged, said contact point located at the adjacent abutting upper side edges of adjacent coupled floor panels.

42. A floor covering panel according to claim 1, wherein said tongue upper side and said groove upper side define engaging abutment surfaces that contact each other when identical ones of said panel are coupled together with a tongue of one panel located in a cooperative groove of another panel, said surfaces extending parallel with a plane including the upper decorative surface, and wherein said abutment surfaces are arranged to guide and maintain said upper side edges in alignment with each other so the upper decorative surfaces are held in alignment.

43. A floor covering panel according to claim 1, wherein the maximum thickness of the lower lip measured from the panel underside and distally of the distal upper lip edge is smaller than the maximum thickness of the upper lip.

44. A floor covering panel according to claims 1, wherein the lower lip is less resistant to bending than the upper lip.

45. A floor covering panel according to claim 1, wherein the upper lip has a chamfered lower edge.

46. A floor covering panel according to claim 1, wherein the contact surfaces are upwardly concave curved with each surface located on a radius centered at the respective adjacent upper edge of the panel, said radii being from 0 to 2 mm different in length from each other.

47. A floor covering panel according to claim 1, wherein when identical ones of said panel are coupled with the panel upper edges in abutment, said contact surfaces meet each other on a circular line having a radius of curvature centered within a circle having a radius of 3 mm and that is centered at the upper edge of the panel including the lower lip.

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48. A floor covering panel according to claim 1, wherein the lower lip has a lower side located in the same plane as the underside of the panel and the upper lip has an upper side that is located in the same plane as the upper surface of the panel.

49. A floor covering panel according to claim 1, wherein the upper lip has a lower side that is coextensive with the upper side of the groove, and the lower lip is located completely below the lower side of the upper lip and the upper side of the groove.

50. A floor covering panel according to claim 1, wherein said tongue and groove are dimensioned and configured such that identical ones of said panel can be coupled together from a position where the cooperative coupling parts of the panels are partially engaged by turning one panel relative to the other and with said turning movement centered at the adjacent upper edges of adjacent panels, and such that during the turning movement the tongue of one panel can freely slide into the groove of the adjacent panel.

51. A floor covering panel according to claim 1, wherein the locking elements have rounded edges.

52. A floor covering panel according to claim 1, wherein the panel has a pair of opposed short sides and a pair of opposed longer sides and wherein the locking means are provided on all four sides, and wherein the common plane of tangency of the contact surfaces on the short side has a steeper inclination than on the longer side.

53. A floor covering panel according claim 1, wherein the tongue and the groove each have a profile susceptible to forming by cutting by rotary milling cutters each having a diameter which is at least 20 times larger than the thickness of the floor panel.

54. A floor covering panel according to claim 1, wherein each coupling part on an edge of the panel has a profile which is susceptible to being formed by rotary milling cutters in only two passes.

55. A floor covering panel according to claim 1, wherein the lower lip has an inclined contact surface which extends in such a manner that the distance from the contact surface to the intersection of the upper side of the panel with the adjacent upper side edge diminishes from a proximal inner end of the contact surface to a distal outer end of said contact surface.

56. A floor covering panel according to claim 1, wherein the floor panel is laminated, and in addition to said core layer includes one or more upper layers, including a decorative layer forming said upper decorative surface, and a backing layer on the underside of the panel.

57. A floor covering panel according to claim 1, wherein at least the contact surfaces are treated with a surface densifying agent.

58. A floor covering panel according to claim 57, wherein said coupling parts are formed of fiberboard.

59. A floor covering panel according to claim 1, wherein the coupling parts are configured so that the panel can be coupled to an identical panel with their cooperative coupling parts engaged and locked against lateral and vertical separation without glue, whereby the panels can be freely disassembled and recoupled together.

60. The floor covering panel according to claim 59, wherein the panel has a pair of opposed short sides and a pair of opposed longer sides and wherein the locking means are provided on all four sides.

61. A method for manufacturing a floor panel claimed in claim 1, comprising milling each of the tongue and groove by means of rotary milling cutters which are positioned at different angles in respect to the floor panel, and carrying out complete milling of each of the tongue and groove in only two passes.

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62. The method according to claim 61, wherein during each of the milling passes, the final shape of one flank of the tongue or the groove is completely formed.

63. The method according to claim 61, wherein during each pass, milling cutters which extend outside the groove and the tongue are applied to the panel edges, said milling cutters having diameters which are from 5 times larger than the thickness of the floor panel to 20 times larger than the thickness of the floor panel.

64. The method according to claim 61, including forming a cooperative coupling part profile on all four sides of the floor panel by displacing the floor panel along two perpendicular directions during milling such that during one of the movements in one direction profiles along two opposite edges of the panel are simultaneously milled and during the movement in the perpendicular direction profiles are simultaneously milled along the remaining opposed edges.

65. A floor covering laminated panel comprising a wood product containing composite core and an upper decorative surface, said panel having an upper side terminating at opposed upper side edges, an underside extending parallel to the upper side, said underside including a backing layer, and side edges terminating at said upper side edges at their upper ends and provided with coupling parts integrally formed in one piece with said core, said coupling parts configured to cooperate by coupling with cooperative coupling parts of an identical one of said panel; said coupling parts comprising a tongue and a groove configured to lock together coupled identical ones of said panel in a direction perpendicular to the plane of the coupled panels when cooperative coupling parts of the panels are engaged, said groove and tongue having respective upper and lower sides, and wherein the panel side edge provided with the groove has an upper lip located above and adjacent the upper side of the groove, and terminating at a distal upper lip edge, and a lower lip extending distally beyond said distal upper lip edge in the plane of the panel; said coupling parts including locking elements formed integrally in one piece with said core, said locking elements including cooperative contact surfaces arranged to be engaged when adjacent identical ones of said panel are coupled together with their coupling parts cooperatively engaged to prevent substantial separation of two

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coupled identical ones of said floor panels at said upper side edges in a direction perpendicular to the edges of the panel sides parallel to the undersides of the coupled floor panels; said locking elements comprising a locking element in the form of a downwardly extending protrusion located on the lower side of the tongue and an upwardly facing cooperating locking recess in the lower lip, said cooperative contact surfaces defined respectively by said protrusion and said recess, and configured, when engaged in a cooperative relationship upon coupling in a common plane of two identical ones of said panel, to meet each other at a common plane that, with respect to the lower lip, is inclined at an angle of 30° to 70° relative to the common plane of the coupled panels, said angle extending inwardly and downward from a distally outer location to a proximal inner location; said composite core comprising a fiberboard; said contact surfaces both being inclined with respect to the lower lip, the inclination of said contact surfaces extending inwardly and downwardly from a distally outer location to a proximal inner location with respect to the lower lip; said contact surfaces located distally beyond said upper lip distal upper lip edge; said coupling parts being dimensioned to provide a coupling free from play in all panel separation directions in a plane extending perpendicular to the side edges when two identical ones of said panel are coupled together; said coupling parts being configured such that two identical ones of said floor panel can be selectively coupled either by laterally sliding and snapping the cooperating coupling parts together or by turning one panel relative to the other with their cooperative coupling parts partially engaged; said lower lip being elastically yieldable at least when two identical ones of said floor panel are coupled by laterally sliding and snapping the cooperative coupling parts together; the complete thickness of said panel is less than 1.5 cm.; and said tongue and groove each having a profile susceptible to forming by cutting by rotary milling cutters.

66. A floor covering panel according to claim 65, wherein the common plane of meeting of the contact surfaces on the short side has a steeper inclination than on the longer side.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,006,486
DATED : December 28, 1999
INVENTOR(S) : Stefan Moriau et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 14,
Line 12; change "means" to -- elements --

Column 16,
Line 15; "mm," to -- cm. --

Column 18,
Line 60; change "means" to -- elements --

Signed and Sealed this

Twenty-first Day of August, 2001

Attest:

Nicholas P. Godici

Attesting Officer

NICHOLAS P. GODICI
Acting Director of the United States Patent and Trademark Office

EXHIBIT B

US006490836B1

(12) **United States Patent**
Moriau et al.

(10) **Patent No.:** **US 6,490,836 B1**
(45) **Date of Patent:** ***Dec. 10, 2002**

(54) **FLOOR PANEL WITH EDGE CONNECTORS**

(75) Inventors: **Stefan Simon Gustaaf Moriau**, Ghent (BE); **Mark Gaston Maurits Cappelle**, Staden (BE); **Bernard Paul Joseph Thiers**, Oostrozebeke (BE)

(73) Assignee: **Unilin Beheer B.V. Besloten Vennootschap**, Nieuwerkerk A/D IJssel (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(63) Continuation of application No. 08/872,044, filed on Jun. 10, 1997, now Pat. No. 6,006,486.

(30) Foreign Application Priority Data

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|---------------|------|----------|
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(58) Field of Search **52/578.1, 589.1, 52/592.1, 590.2, 592.7, 586.1, 570, 572, 591.1, 590.1**

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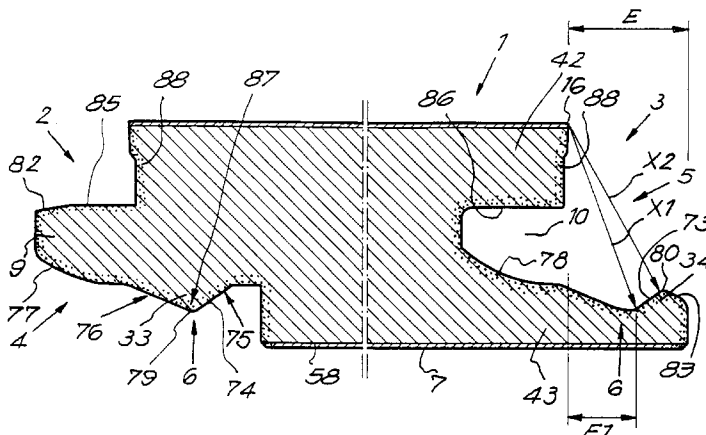
Primary Examiner—Yvonne M. Horton

(74) *Attorney, Agent, or Firm*—Bacon & Thomas

(57) ABSTRACT

Floor covering, including hard floor panels (1) which, at least at the edges of two opposite sides (2-3, 26-27), are provided with coupling parts (4-5, 28-29), cooperating with each other, substantially in the form of a tongue (9-31) and a groove (10-32), wherein the coupling parts (4-5, 28-29) are provided with integrated mechanical locking elements (6) which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges (2-3, 26-27) and parallel to the underside (7) of the coupled floor panels (1).

30 Claims, 10 Drawing Sheets



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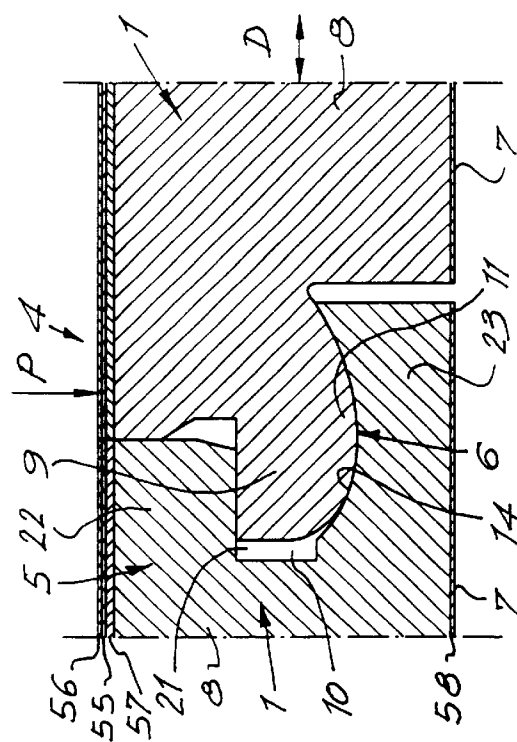
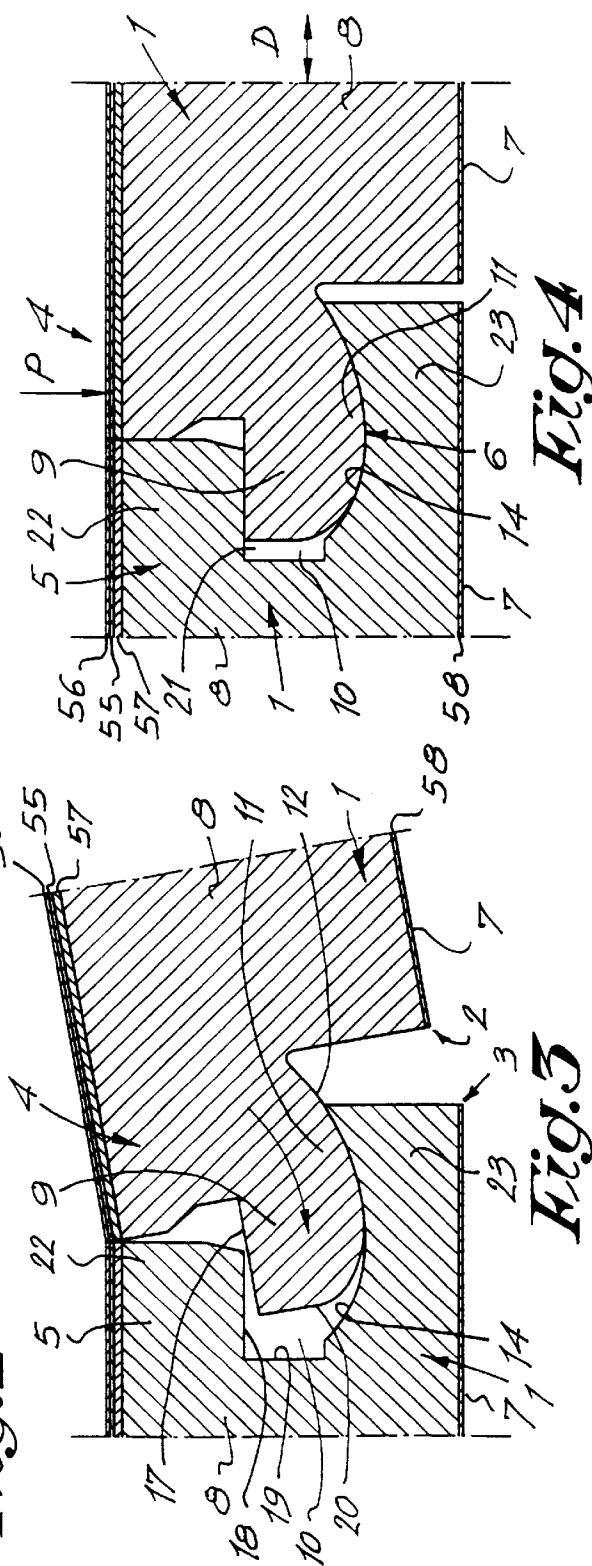
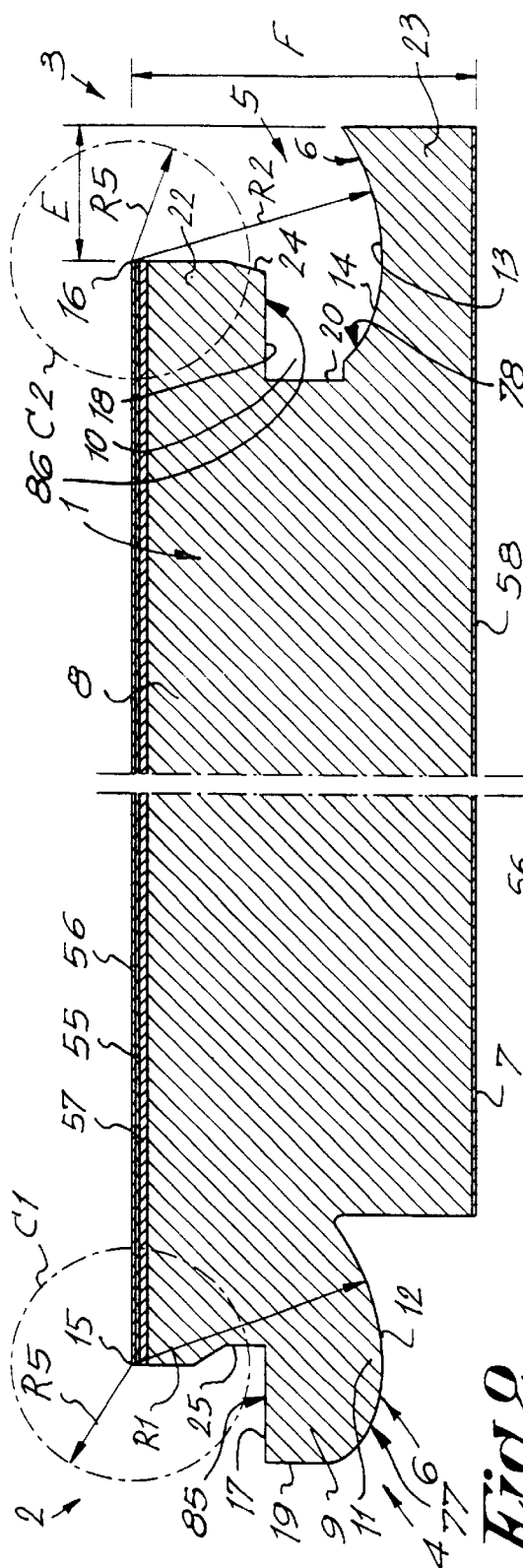
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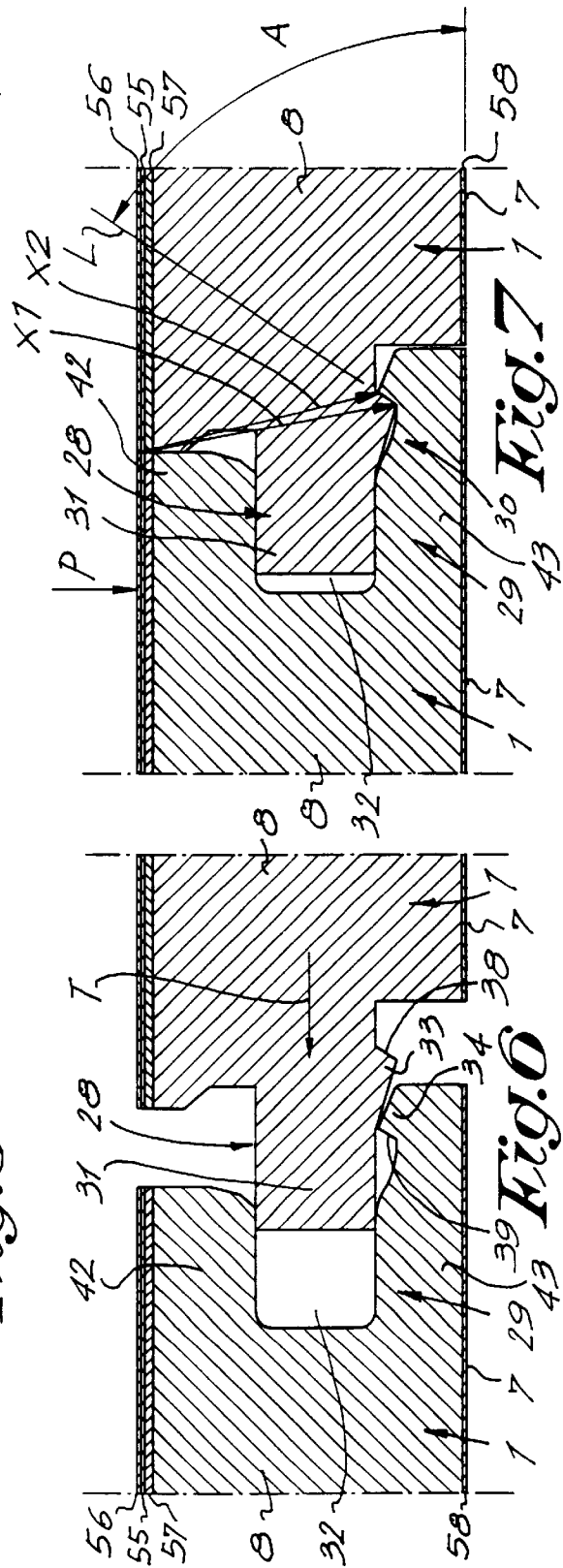
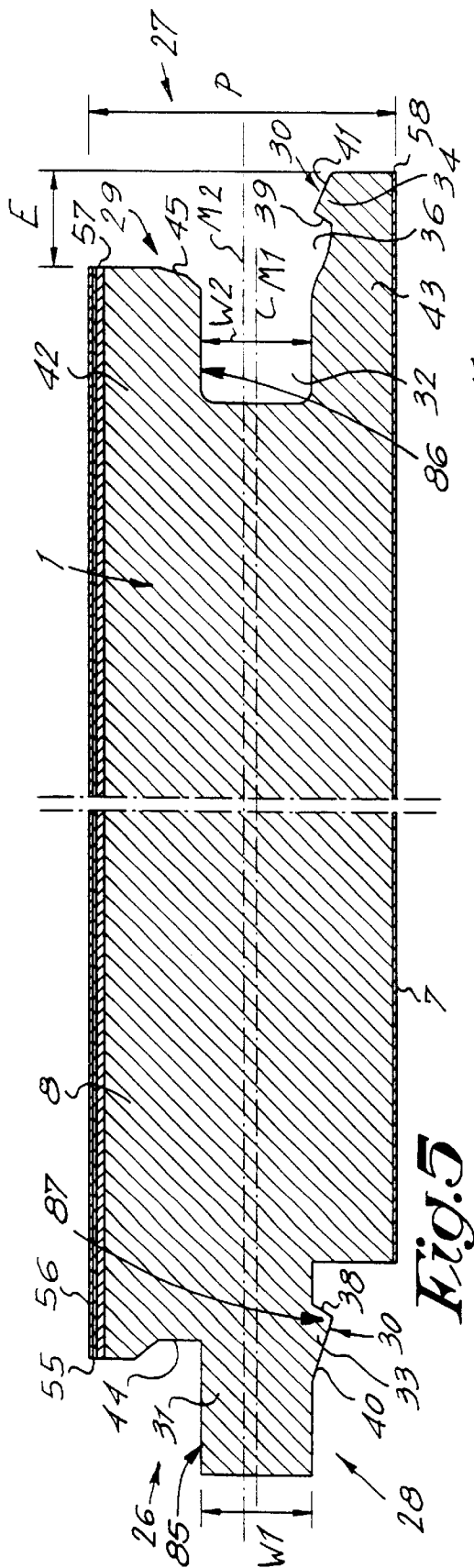
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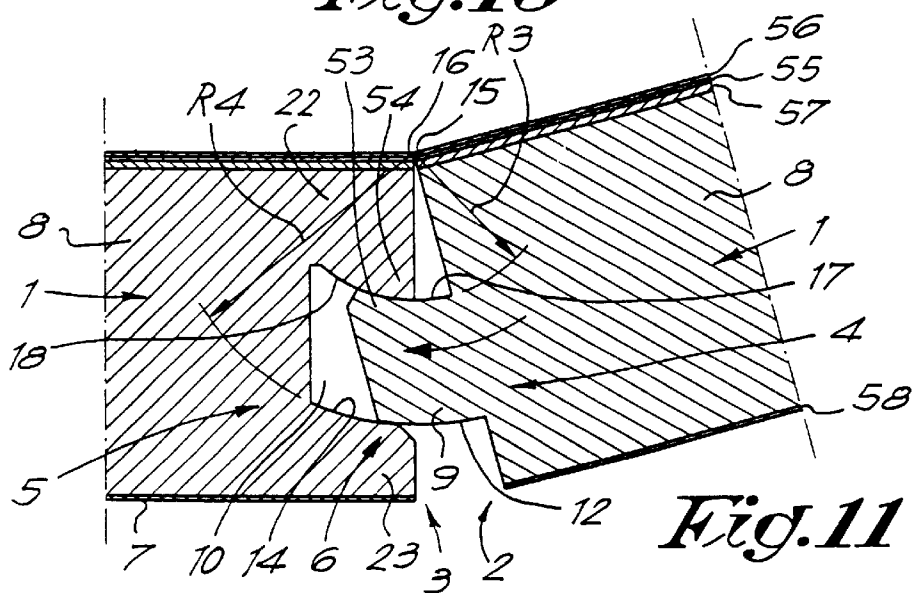
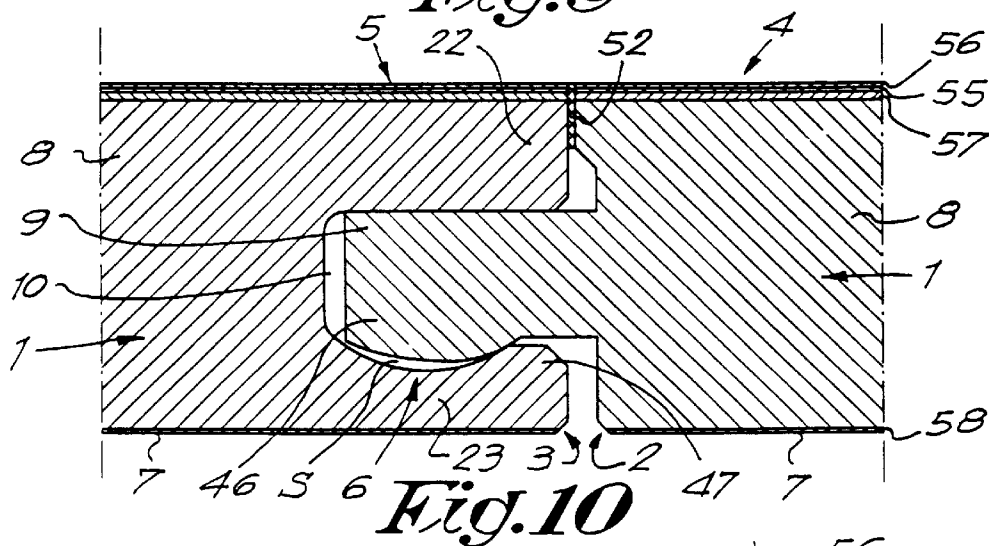
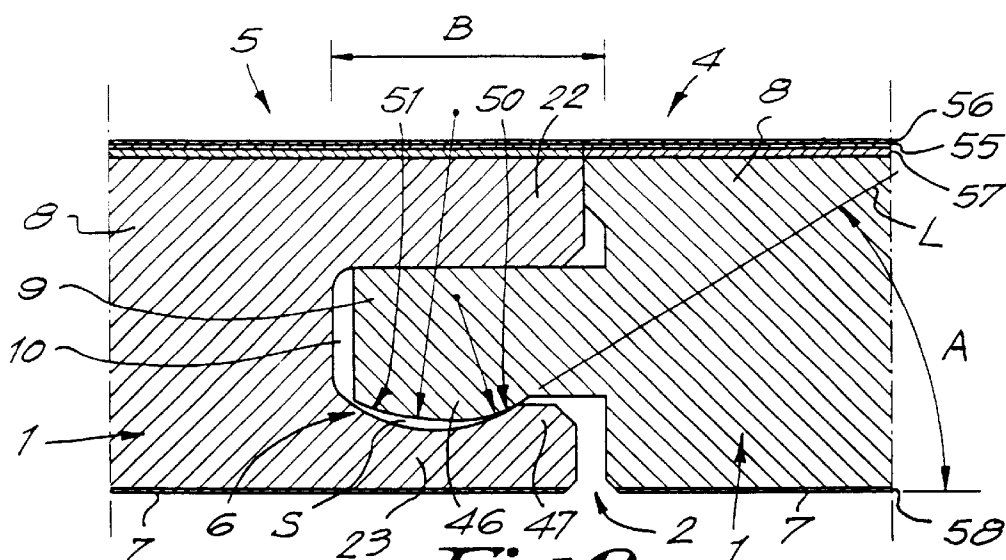
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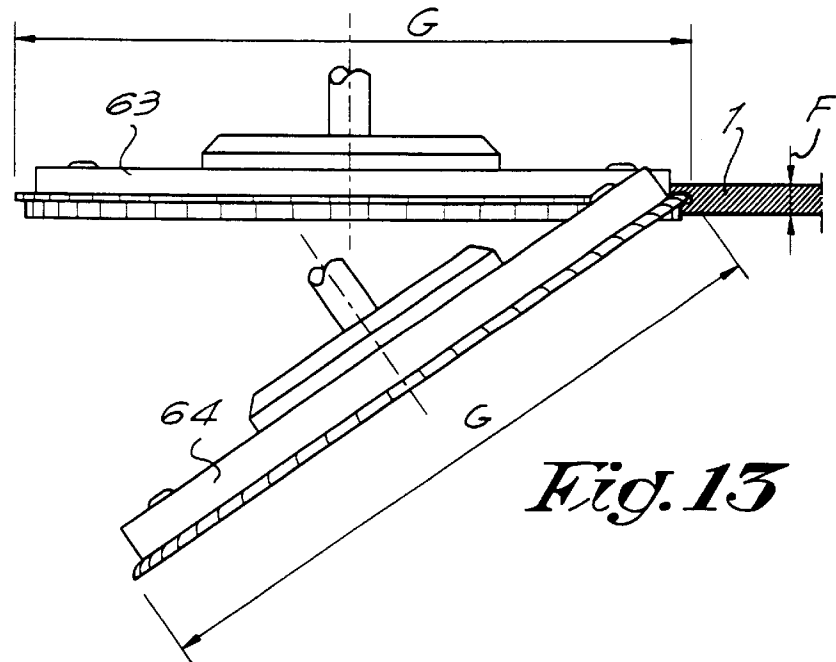
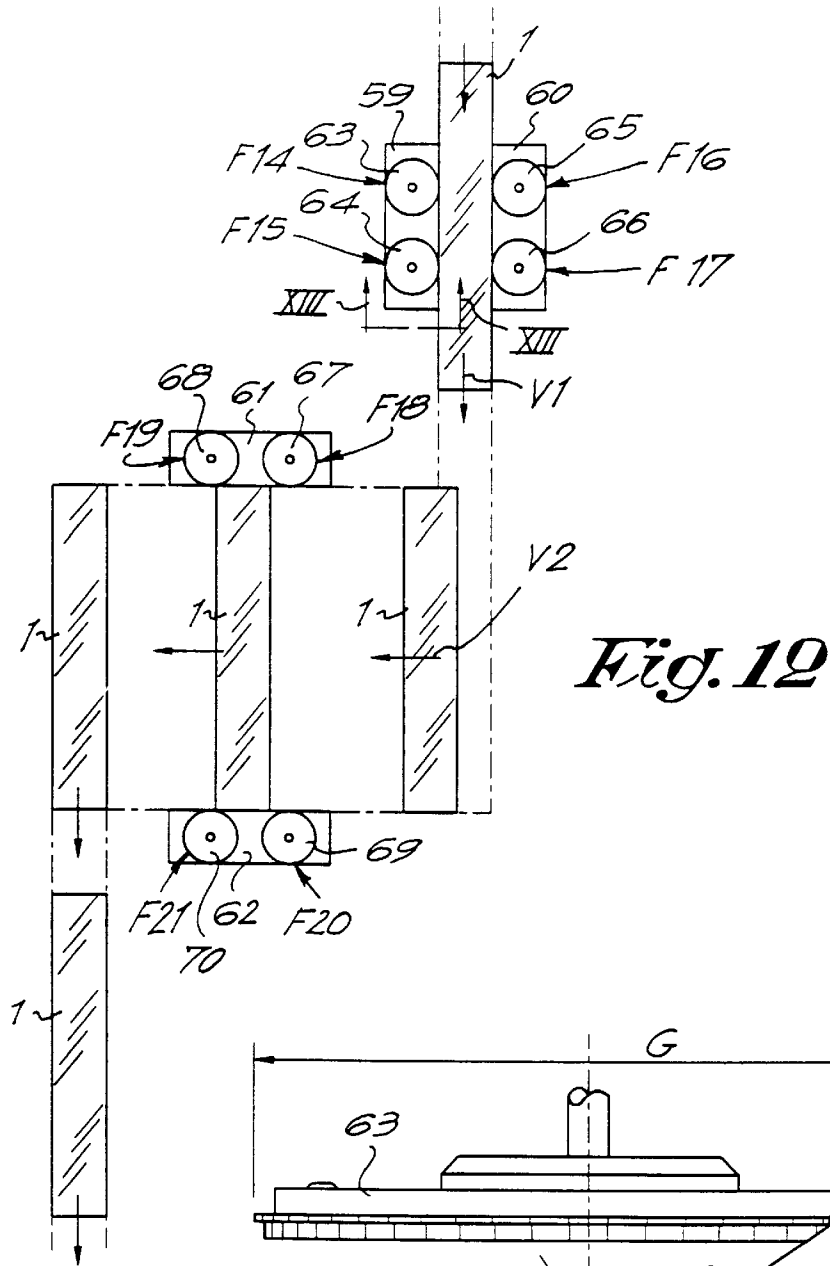


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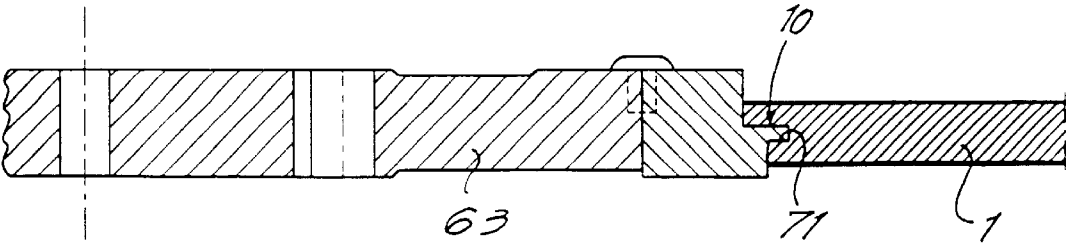


Fig. 14

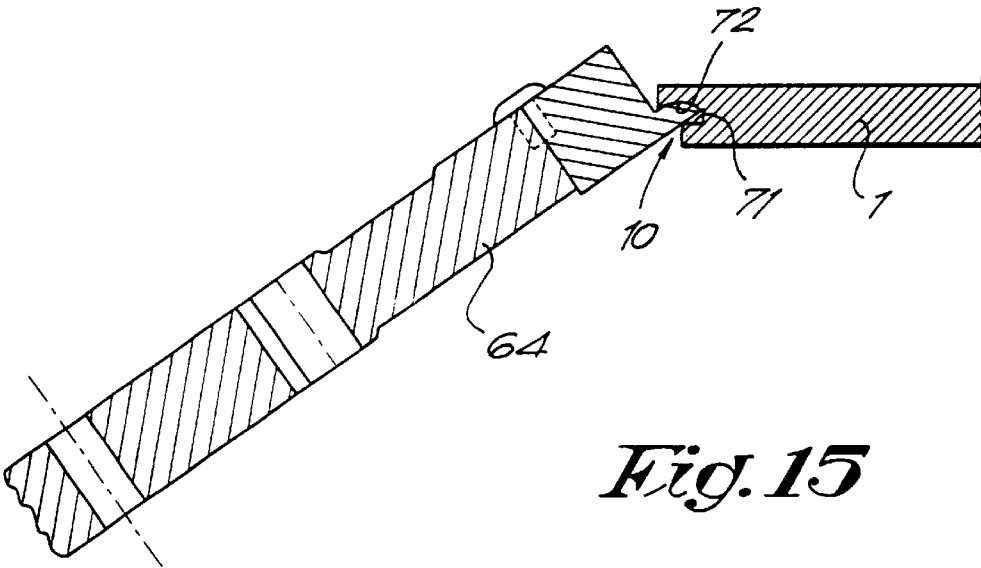


Fig. 15

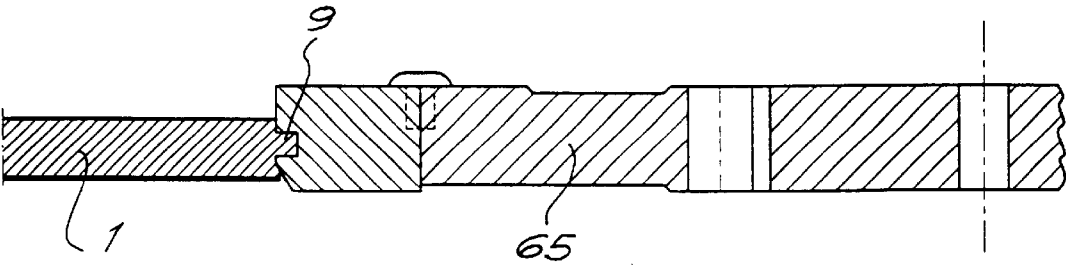


Fig. 16

Fig. 17

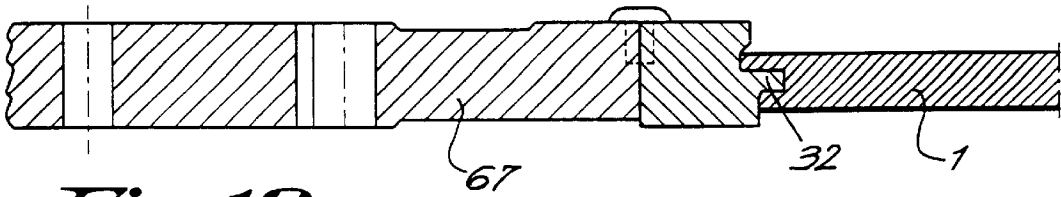
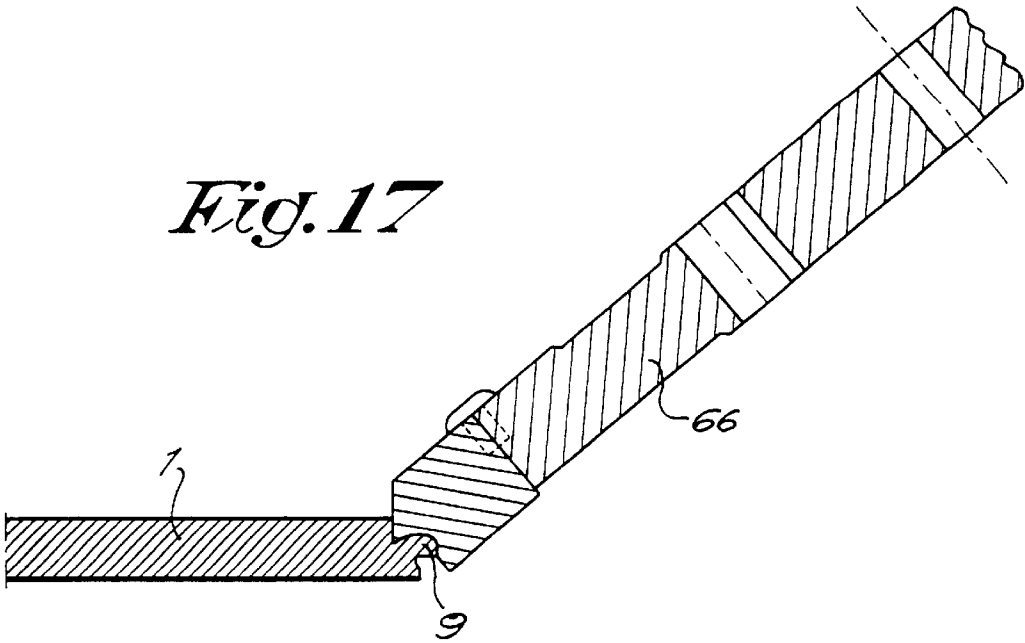


Fig. 18

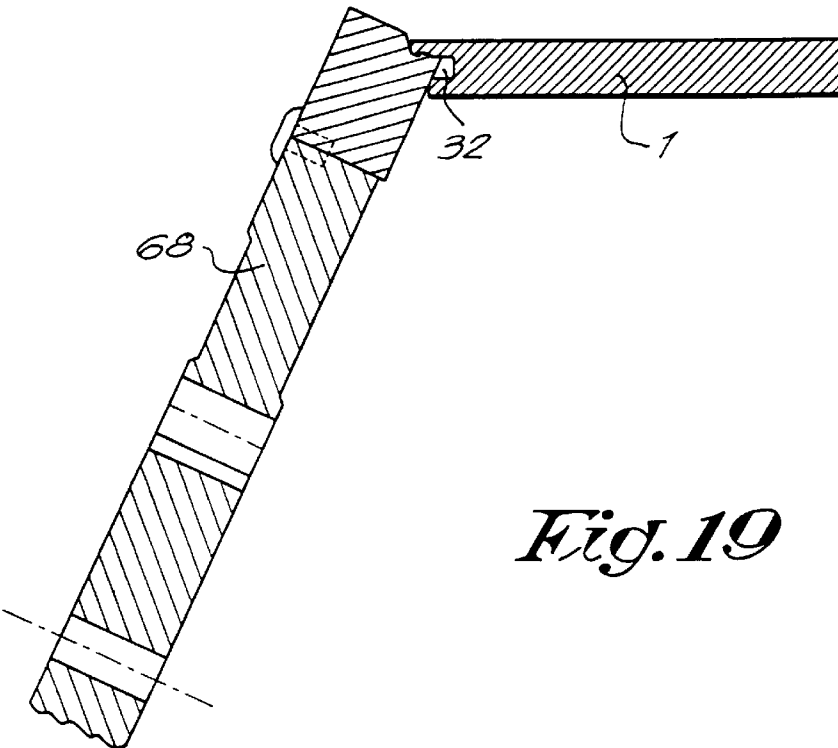


Fig. 19

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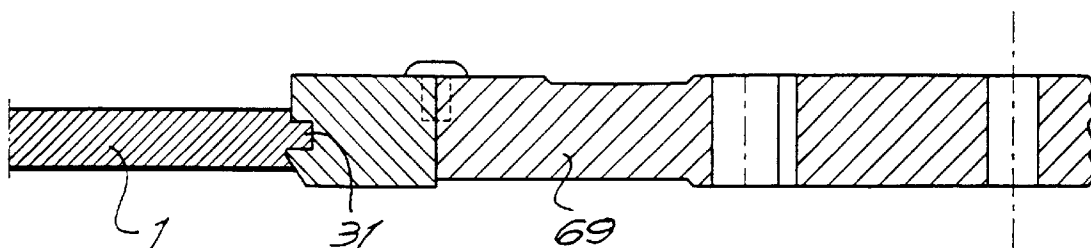


Fig. 20

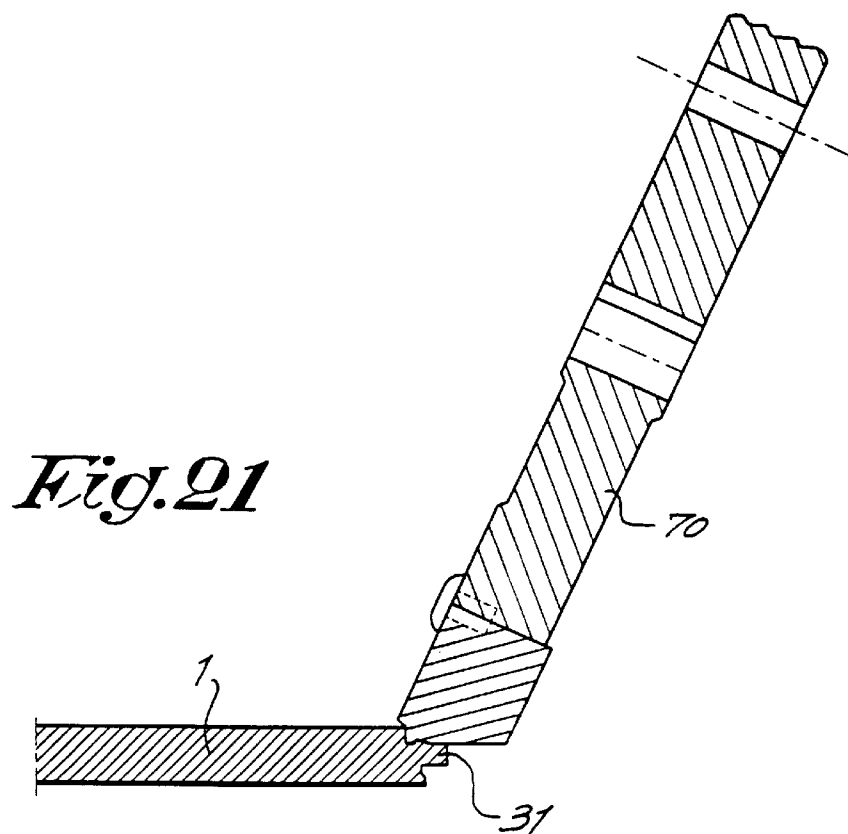
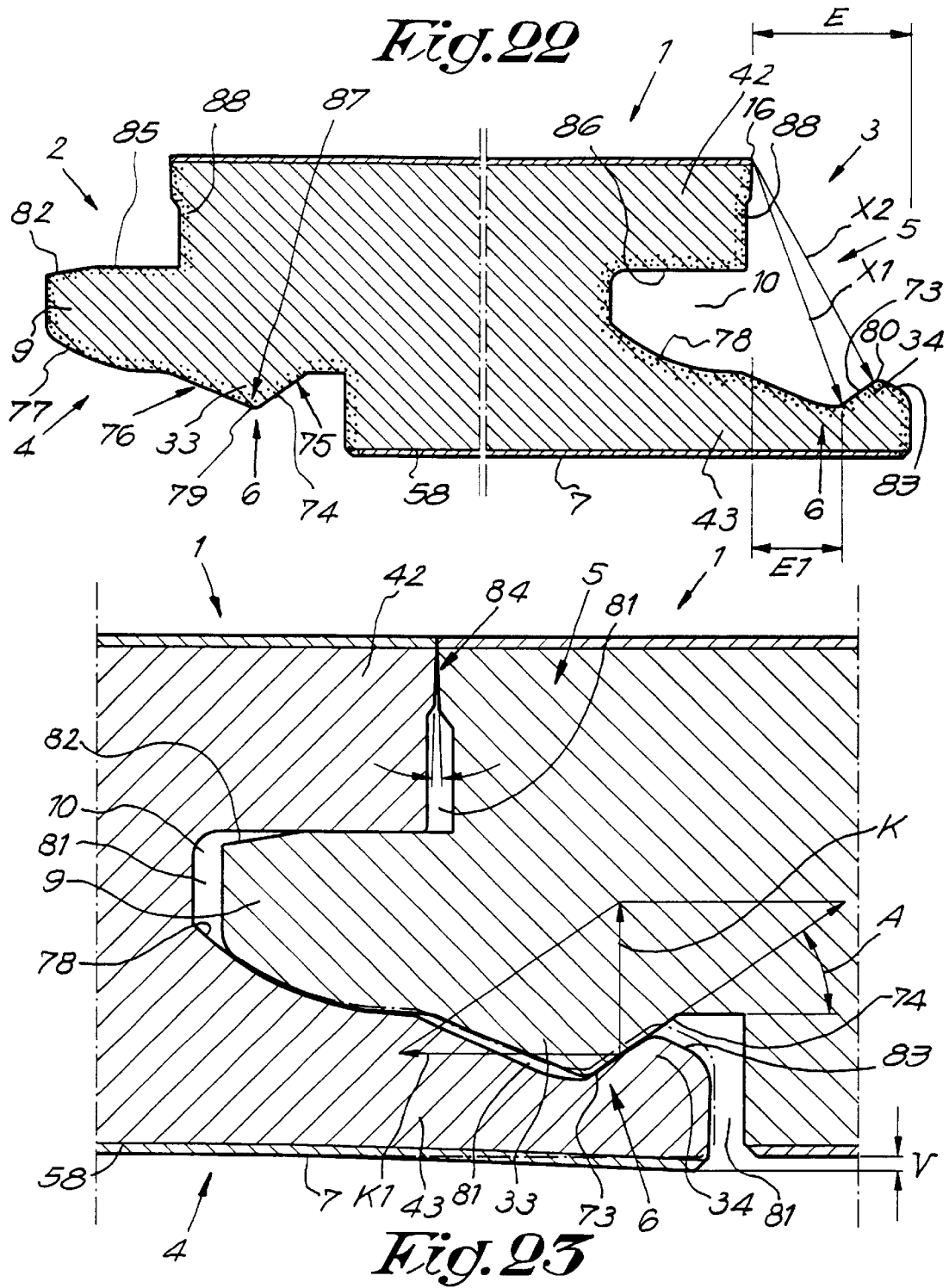
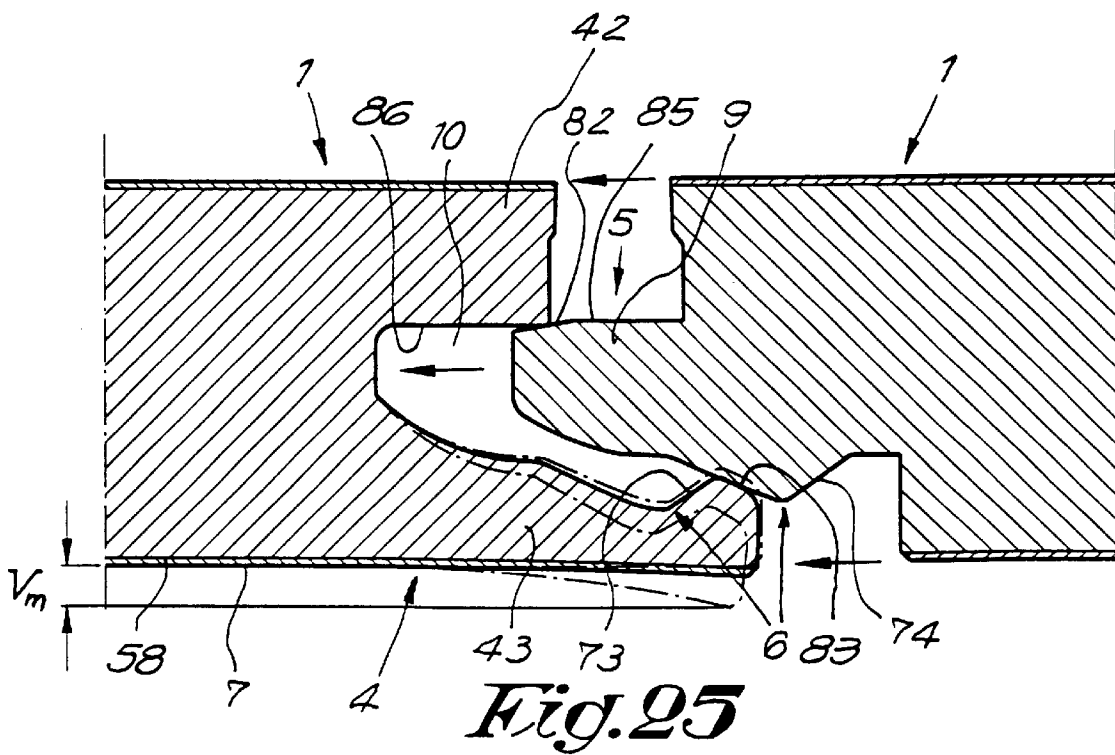
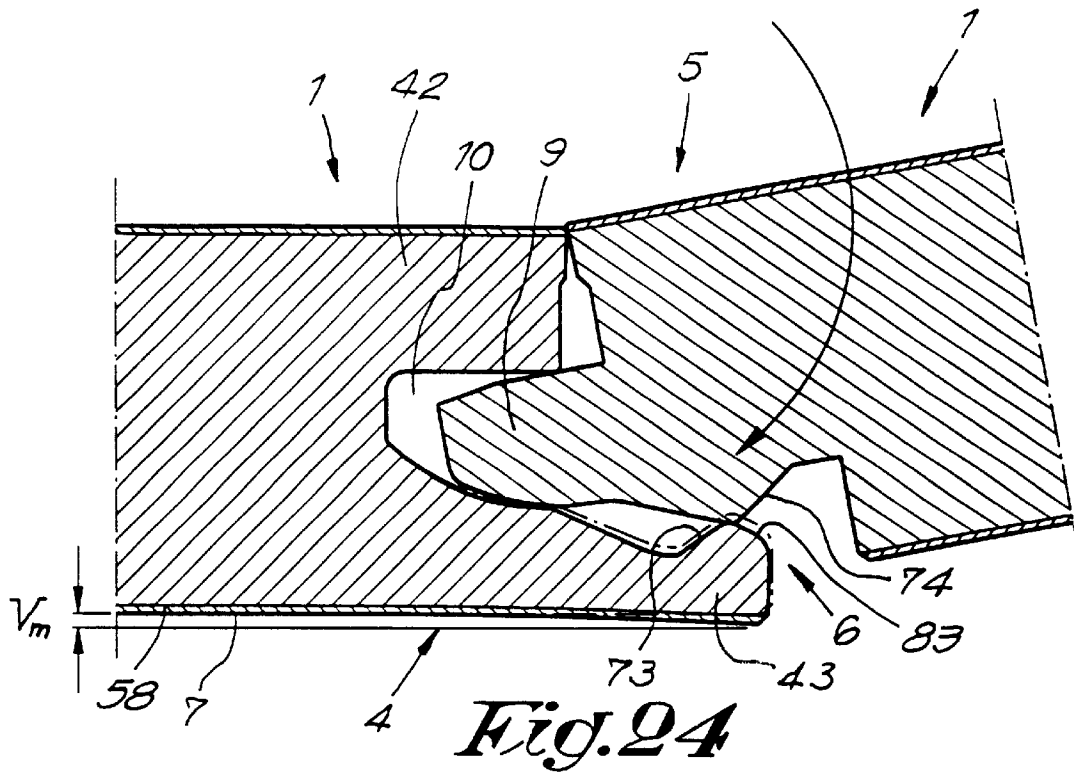


Fig. 21





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FLOOR PANEL WITH EDGE CONNECTORS**RELATED APPLICATION DATA**

This application is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997 now U.S. Pat. No. 6,006,486. 5

BACKGROUND OF THE INVENTION**1. Field of the Invention**

This invention relates to a floor covering, made of hard floor panels. 10

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring. 15

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached to the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels. 20

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena. 25

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks. 30

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation. 35

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280. 40

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible. 45

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry. 50

Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels. 55

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BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimalized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith. 30

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted. 35

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips. 40 45 50 55

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Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can

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be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. 1 represents a floor panel of a floor covering according to the invention;

FIG. 2, on a larger scale, represents a cross-section according to line II—II in FIG. 1;

FIGS. 3 and 4 represent how two floor panels with coupling parts according to FIG. 2 match into each other;

FIG. 5, on a larger scale, represents a cross-section according to line V—V in FIG. 1;

FIGS. 6 and 7 represent how two floor panels with coupling parts according to FIG. 5 match into each other;

FIGS. 8 to 11 represent a number of variants of coupling parts of floor panels according to the invention;

FIG. 12 schematically represents how the floor parts can be provided with coupling parts;

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FIG. 13 represents a cross-section according to line XIII—XIII in FIG. 12;

FIGS. 14 to 21, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. 12 with arrows F14 to F21;

FIG. 22 represents a floor panel according to the invention;

FIG. 23, on a larger scale, represents the coupling of two floor panels of FIG. 22;

FIGS. 24 and 25 represent two manners of coupling floor panels according to FIG. 22 to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels 1, for example, such as a laminated panel as shown in FIG. 1.

These floor panels 1 can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. 1, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is, at least at the edges of two opposite sides 2-3, provided with coupling parts 4-5 which permit two adjacent identical floor panels 1 to be coupled to each other.

According to the invention, the coupling parts 4-5, as represented in the FIGS. 2 to 4, are provided with integrated mechanical locking parts or locking elements 6 which prevent the drifting or sliding apart of two coupled floor panels 1 in a direction D perpendicular to the respective sides 2-3 and parallel to the underside 7 of the coupled floor panels 1; the coupling parts 4-5 and the locking elements 6 are formed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two subsequent floor panels 1 can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel 1 can be laterally inserted into the previous; and the coupling parts 4-5 preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels 1 with an elongated shape, as represented in FIG. 1, the respective coupling parts 4-5 are located at the longitudinal sides 2-3.

The coupling parts 4-5 can be realized in various forms, although the basic forms thereof will always be formed by a tongue 9 and a groove 10.

In the form of embodiment of FIGS. 2 to 4, the related floor panel 1 is provided with coupling parts 4-5 and locking means or locking elements 6 which allow two floor panels 1 to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements 6 consist of a first locking element 11, formed by a protrusion with a bent round shape at the lower side 12 of the tongue 9, and a second locking element 13 (shown in FIG. 2), formed by a recess with a bent hollow or downwardly concave shape in the lower wall 14 of the groove 10.

The locking elements 11-13 ensure that two floor panels 1 which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels 1 to be inserted into each other by means of a turning movement, the curvatures

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preferably are circular. The bottom side 12 of locking means or locking elements 6 has a curvature with a radius R1, the center of which coincides with the respective upper edge 15 of the floor panel 1, whereas the lower wall 14 of the locking part 5 has a curvature with a radius R2 which is equal to the radius R1, but its center coincides with the respective upper edge 16. Radii R1 and R2 may also be applied which are larger or smaller than the distance to the upper edge 15, 16 respectively, and/or which differ from each other in size.

The upper side 17 of the tongue 9 and the upper wall or side 18 of the groove 10 are preferably flat and preferably are located in the horizontal plane.

The inner side 20 of the groove 10 and the 4 front side 19 of the tongue 9 of the two interlocked floor panels 1 preferably do not fit closely against each other, such that an intermediate space 21 is created between them into which possible dust remainders or such can be pushed away by means of the tongue 9.

The tongue 9 and the groove 10 preferably have shapes which are complementary to each other, such that the tongue 9 in the engaged condition of two identical floor panels 1 precisely sits against the upper wall 18 and the lower wall 14 of the groove 10, whereby a pressure P, exerted against the upper lip 22, is received or reacted not only by this lip 22, but by the complete structure, because this pressure can be transmitted through the tongue 9 and the lower lip 23 to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer 24 and lip 22 on a recess 25 can be provided, as represented in FIGS. 2 to 4, as a result of which the subsequent floor panels 1 can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. 5 to 7, the floor panels 1 according to the invention can also, along the sides 26-27 which are at a right angle to the sides 2-3, be provided with coupling parts 28-29 which have locking elements 30, too. The coupling parts 28-29 are preferably also realized in the shape of a tongue 31 and a groove 32. Hereby, the locking elements 30 do not have to be of the same nature as the locking elements 6.

Preferably, at the sides 26-27 locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. 6 and 7. To this aim, the locking elements 30 consist of a snap-together connection with locking elements 33 and 34 which grip behind each other.

As represented in FIGS. 5 to 7, the locking element 33 preferably consists of a protrusion of the lower side 35 of the tongue 31 which can be located in a recess 36 in a lower lip 43 extending distally from the lower wall 37 of the groove 32. The locking element 34 is formed by the upward directed part or protrusion which defines the distally outer end of recess 36.

In this case, the locking elements 33-34 have contact surfaces 38-39 which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces 38-39, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside 7, which angle is smaller than 90°.

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The locking elements **33–34** preferably are provided with inclined portions **40** and **41** which, when two floor panels **1** are engaged, cooperate with each other in such a manner that the locking elements **33–34** can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. **6** and **7**).

The thickness **W1** of the tongue **31** preferably is equal to the width **W2** of the groove **32**, such that compression pressure **P** applied to the upper lip **42** is reacted by the tongue **31** which, in its turn, then is reacted by the lower lip **43**.

Analogous to the chamfer **24** and recess **25**, a recess **44** and a chamfer **45** are provided also at the edges **28–29**.

It is noted that such a snap-together coupling can also be applied at the edges **2–3**. Hereby, this can be a snap-together coupling analogous to these of FIGS. **5** to **7**, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. **8** and **9**. Contrary to the locking elements **33–34** which consist of rather local protrusions, in the forms of embodiment of FIGS. **8** and **9** use is made of locking elements **46–47** which, in comparison to the total width **B** of the coupling, extend over a rather large distance.

In this case, the locking elements **46–47** are also provided at the lower side **12** of the tongue **9** and the lower wall **14** of the groove **10**.

According to FIG. **8**, the locking elements **46–47** have contact surfaces **48–49** which are at an angle with the plane of the floor panel **1**. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. **9**, the locking elements **46–47** possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements **46–47** hereby consist of curved surfaces. The common plane of tangency **L** forms an angle **A** which is smaller than 90° , and more preferably is smaller than 70° .

In this manner, the locking element **46** preferably has two portions with a different curvature, on one hand, a portion **50** with a strong curvature and, on the other hand, a portion **51** with a weak curvature. The portion **50** with the strong curvature provides for the formation of a firm coupling. The portion **51** with the weak curvature facilitates the coupling parts **4–5** to be brought into each other easily. The intermediate space **S** forms a chamber which offers space for dust and the like which, when engaging two floor panels **1**, inevitably infiltrates there.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. **7** to **9**, preferably the tongue **9–31** has a shape that thickens from below, which then can cooperate with a widened portion in the groove **10**.

In FIG. **10**, a variant is represented whereby at least at the level of the upper edges **15–16**, a sealing material **52** is provided, as a result of which a watertight sealing can be assured. This sealing material **52** may consist of a strip or covering which is provided previously at the floor panel **1**, either at one or both upperside edges **15–16**.

In FIG. **11**, a further variant is represented, whereby the locking element **6** is formed by an upward directed portion **53** at the tongue **9**, which as a result of a turning movement of the panel, is brought behind a downward-directed portion **54** on the upper wall **18**. More particularly, this is obtained by forming the upper side **17** and the upper wall **18** with a

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curvature **R3**, the center of which is situated at the upperside edges **15–16**, and forming the lower side **12** and the lower wall **14** with a radius **R4**, the center of which is also situated at the upperside edges **15** and **16**, respectively. These radii **R3–R4** can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius **R1**, **R3** respectively, and, on the other hand, the radius **R2**, **R4** respectively, preferably should not be larger than **2 mm**.

It is also preferred that the center of these radii be situated inside the circle **C1**, **C2** (see FIG. **2**) respectively, which extends with a radius **R5** of **3 mm** centered at upperside edge **15**, **16** respectively.

Finally is noted that, according to the invention, the lower lip **23–43**, as represented in FIGS. **2** to **7**, can be formed distally longer than the upper lip **22–42**. This has an advantage that the coupling parts **4–5–28–29** can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels **1**, because each subsequent floor panel **1** during installation can be placed upon the protruding lower lip **23–43**, as a result of which the tongue **9–31** and the groove **10–32** automatically are positioned in front of each other.

The embodiments wherein the lower lip **23** is equal to or distally shorter than the upper lip **22**, in their turn, offer the advantage that no protruding lip **23** remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference **E** between the distally outer edge of the upper lip **22–42** and the distally outer edge of the lower lip **23–43**, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove **10**, should preferably be kept smaller than one time the total thickness **F** of the floor panel **1**. For stability's sake, normally this total thickness **F** shall never be less than **5 mm**.

The small dimension of the difference **E** offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line **M1** through the tongue **9** and the groove **10** is situated lower than the center line **M2** of the floor panel **1**, such, that the upper lip **22–42** is thicker than the lower lip **23–43**. In first instance, this is essential in this kind of connection, because then it is the lower lip **23–43** which bends, whereby the upper side of the floor panel **1** is kept free of possible deformations.

As explained in the introduction, for the core **8** a material is chosen from the following series:

- a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;
- a product based on synthetic material;
- chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. **2** to **11**, such laminated flooring preferably consists of a core **8** made of MDF medium density fiberboard board, HDF high density fiberboard board or similar, whereby at least at the upper side of this core **8** one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer **55** and a protective

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top layer **56**. The decorative layer **55** is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer **56** preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer **57** upon which the decorative layer **55** is provided.

Preferably, also a backing layer **58** shall be applied at the underside **7**, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel **1**. This backing layer **58** may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. **12**, the tongue **9** and the groove **10**, and preferably also the tongue **31** and the groove **32** are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels **1** preferably shall be displaced by means of two sequential perpendicular movements **V1** and **V2**, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices **59–60**, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices **61–62**. During these processing, the floor panels **1** preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue **9–31** and groove **10–32** are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel **1**.

This is illustrated in FIGS. **13**, **14** and **15**, wherein it is represented how a groove **10** is realized by means of two milling cycles by means of two milling cutters **63** and **64**. FIGS. **16** and **17** represent how the tongue **9** is shaped by means of milling cutters **65** and **66**.

The FIGS. **18–19** and **20–21** represent similar views showing how the groove **32** and the tongue **31** are shaped by means of milling cutters **67–68** and **69–70**, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter **63** of FIG. **14** determines the final shape of the lower flank **71** of the groove **10**, whereas the milling cutter **64** determines the final shape of the upper flank **72**.

As mentioned in the introduction, preferably milling cutters **63** to **72** shall be used, having diameters **G** which are at least 5 times, and even better at least 20 times larger than the thickness **F** of the floor panels **1**.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. **22** to **25**, a particularly preferred form of embodiment of a floor panel **1** according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

An important characteristic herein consists in that the coupling parts **4–5** are provided with locking elements **6** which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of

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which the engaged floor panels **1** are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip **43**, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels **1** being forced towards each other. The resultant bending **V**, as well as the tension force **K**, are indicated in the enlargement view of FIG. **23**.

In order to obtain the tension force **K** pressing together the engaged floor panels **1**, the bendable portion, in this case the lip **43**, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface **73** which preferably can cooperate with a corresponding contact surface **74** on tongue **9**. These contact surfaces **73–74** are similar to the aforementioned contact surfaces **39–38** and also similar to the inclined portions of the lower lip of FIGS. **2** to **4**.

In the FIGS. **2** and **5**, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. **23** can be realized.

Due to, on one hand, the contact along the angle **A**, and, on the other hand, the fact that a tension force **K** is created, a compression force component **K1** is produced, as a result of which the floor panels **1** are drawn against each other in compression.

Preferably, the angle **A** of the mutual plane of tangency of contact surfaces **73–74** relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force **K** is realized, an angle **A** of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels **1** and, on the other hand, to ensure that the floor panels **1** can easily be engaged and respectively disassembled.

Although the pressing or compression force component **K1** preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending **V** is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending **V** of the lip **43** only produces local bending of the underlayer.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4–5**, including the locking elements **33–34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of

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the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. **22** to **25** consists in that the floor panels **1** can be selectively engaged by means of a turning movement, as represented in FIG. **24**, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. **25**, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending V_m results in the coupling parts, more particularly in the lip **43**, which bending V_m is less pronounced, if not nonexistent, as in the FIGS. **2** to **4**, in comparison to the bending V_m which results when the floor panels **1** are engaged by means of shifting them towards each other, as in FIG. **15**.

The advantage of this consists in that the floor panels **1** can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel **1** can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts **4-5** shown in FIGS. **22** to **25** can also be used for the coupling parts **28-29** of the short sides of the panels.

According to the invention, in the case that the four sides **2-3-26-27** are provided with coupling parts **4-5-28-29**, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels **1**, for example, such as represented in FIG. **1**, the locking at the small sides **26-27** preferably shall be more pronounced than at the longitudinal sides **2-3**. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces **73-74** with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element **33**, is bounded by at least two portions **75-76** (shown in FIG. **22**), respectively a portion **75** with a strong (steep) inclination which provides for the locking, and a portion **76** with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. **22** to **25**, these portions **75-76** are formed by straight planes, but, as already described with reference to FIG. **9**, use can also be made of curved portions **50-51**. In FIG. **5**, these are the contact surface **38** and the inclined portion **40**.

In the preferred form of the invention, the floor panels **1** comprise coupling parts **4-5** and/or **28-29** exhibiting one of the following or the combination of two or more of the following features:

a curvature **77** (shown in FIG. **22**) at the lower side of the tongue **9** and/or a curvature **78** at the lower lip **43** which form a guidance when turning two floor panels **1** into each other, with the advantage that the floor panels **1** can be engaged into each other easily during installation;

roundings **79-80** at the edges of the locking elements **33-34**, with the advantages that the locking elements

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can easily shift over each other during their engagement, or during disassembly of the floor panels **1** and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;

dust chambers **81**, or spaces **21** as in FIG. **4**, between all sides, directed laterally towards each other, of the engaged floor panels **1**, with the advantage that inclusions which get between the floor panels **1** during the engagement do not exert an adverse influence upon good engagement;

a shaping of the tongue **9** which is such, for example, by the presence of a chamfer **82**, that the upper side of the tongue **9** becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip **42** when the floor panels **1** are pushed towards each other in substantially the same plane, as indicated in FIG. **25**, with the advantage that the front extremity or end of the tongue **9** does not press against the front side of the upper lip **42** or the front edge of the bottom lip **43** when the floor panels are pushed towards each other in the same plane;

a ramp surface **83**, hereinbefore also called inclined portion **41**, formed at the distally outer end of the lower lip **43**, with the advantage that the locking elements **33-34** shift smoothly over each other and that the lower lip **43** is bent uniformly;

in the engagement direction only one important contact point which is formed by a section **84** at the location of the upperside edges of the floor panels **1**, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels **1** and that the development of openings between the floor panels **1** is counteracted;

contact surfaces **85-86**, more particularly abutment surfaces, formed by the upper side of the tongue **9** and the upper side of the groove **10** which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels **1**, as well as contact surfaces cooperating with each other, formed by curvatures **77-78**, with the advantage that no mutual displacement in height between two engaged floor panels **1** is possible, even if the insertion depth of the tongue **9** into the groove **10** should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. **22** to **25**, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. **2** to **11**, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. **5** to **7** and **22** to **25**, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element **6**, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip **23-43** which extends beyond the distal edge of the upper lip **22-42**, more particularly, the lowermost point **87** of the locking part **33** is situated under the top layer of the floor panel **1**. For clarity's sake, this top layer is indicated in the FIGS. **22-25** only as a single layer.

It should be noted that the combination of features, the lower lip **23-43** extending further than the upper lip **22-42**; the locking elements **6** being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the

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portion of the lower lip **23–43** which extends distally beyond the upper lip **22–42**, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels **1** can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip **23–43** adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface **39** or **73**, preferably extends in such a manner that the distance between the upper edge **16** of the panel to the contact surface **39**, **73** diminishes between the proximal and distal ends of the sloping contact surface **39**, **73**, in other words, such that, as represented in FIG. **22**, the distance **X2** is smaller than the distance **X1**. This is also the case in FIG. **7**.

Still preferably, this portion only starts at a clear distance **E1** from the outer edge of upper lip **42**.

It is obvious that the coupling parts **22** to **25** can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels **1** are treated at their sides **2–3** and/or **26–27** with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. **22**, such impregnation **88** is represented schematically. This treatment can be performed over the complete surface of the sides **2–3** and/or **26–27** or only over specific portions hereof, for example exclusively on the surfaces of the tongue **9** and the groove **10**.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts **4–5** and/or **28–29** better keep their shape and strength, even if the floor panels **1** are engaged and disassembled repeatedly. In particular, if the core **8** is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels **1** can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

What is claimed is:

1. A floor covering comprising a hard floor panel having a substantially planar underside and at least two opposed side edges, said side edges including complementary coupling parts configured to cooperate with identical cooperative complementary coupling parts of another one of said panel, said coupling parts comprising substantially a tongue and a groove extending along panel side edges generally parallel to the panel underside and including integrated

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mechanical locking elements, said tongue, groove and locking elements formed in one piece with the panel, said tongue, groove and locking elements arranged to prevent drifting apart of the floor panel when coupled by said coupling parts to another one of said floor panel in a direction perpendicular to the adjacent side edges of the coupled panels, and parallel to the underside of the panel; a coupling part of said panel, when engaged with a complementary coupling part of another one of said panel, configured and arranged to produce a biasing force between such coupled panels tending to urge the panels towards each other; at least one of said coupling parts including an elastically bendable portion having a relaxed unbent position, and which, when in a coupled condition, is at least partially bent out of its normal relaxed position and thereby provides said biasing force;

wherein the elastically bendable portion of said one of said coupling part comprises a lower lip defined at least in part by a lower side of the groove of said coupling parts, said lower lip cooperating with a mating portion of a tongue of a cooperating coupling part;

wherein said lip when bent extends in a downward direction relative to the panel underside when the panel is coupled by cooperative complementary coupling parts to another one of said panel;

wherein the panel comprises a core comprising a material selected from the group consisting of HDF and MDF board; said lower lip is substantially formed of said core; one of said locking elements comprises a recess in said lower lip, said recess having a lowermost bottom area; said groove having a deepest point within the panel; and wherein said elastically bendable portion of the lower lip comprises a portion of said lower lip located between the deepest point of said groove and the lowermost bottom area of said recess;

wherein the bendable portion of the lower lip includes a side wall of said recess that slopes downwardly in a direction extending from a distally outer area of said lip towards a proximally inner area of said lip.

2. A floor covering comprising a hard floor panel having a substantially planar underside and at least two opposed side edges, said side edges including complementary coupling parts configured to cooperate with identical cooperative complementary coupling parts of another one of said panel, said coupling parts comprising substantially a tongue and a groove extending along panel side edges generally parallel to the panel underside and including integrated mechanical locking elements, said tongue, groove and locking elements formed in one piece with the panel, said tongue, groove and locking elements arranged to prevent drifting apart of the floor panel when coupled by said coupling parts to another one of said floor panel in a direction perpendicular to the adjacent side edges of the coupled panels, and parallel to the underside of the panel; a coupling part of said panel, when engaged with a complementary coupling part of another one of said panel, configured and arranged to produce a biasing force between such coupled panels tending to urge the panels towards each other; at least one of said coupling parts including an elastically bendable portion having a relaxed unbent position, and which, when in a coupled condition, is at least partially bent out of its normal relaxed position and thereby provides said biasing force;

wherein said floor panel is rectangular and includes two pairs of opposed side edges; said coupling parts and locking elements are provided on all side edges of the

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panel; and wherein said locking elements are provided on at least two side edges that are perpendicular to and meet each other whereby, when the panel is coupled with complementary coupling parts of identical ones of said panel at all opposed edges, the panels are locked together by said locking elements at all coupled side edges;

wherein said coupling parts are configured and arranged to enable coupling of complementary coupling parts of identical ones of said panel to each other by rotation of one panel relative to the other, said coupling parts configured such that upon rotation of one panel relative to the other panel the elastically bendable portion of one coupling part is bent; and wherein at coupled side edges of the coupled panels the coupling parts are configured such that one panel is movable relative to the other by shifting the one relative to the other in a direction parallel to the coupled side edges; said shifting of one panel relative to the other maintaining the bent condition of the elastically bendable portion of the lower lip while the panels are coupled.

3. A method of assembling a floor covering comprising cooperating rectangular hard floor panels each having a substantially planar underside and at least two opposed side edges including complementary coupling parts arranged to cooperate with identical complementary coupling parts of another one of said panels, said complementary coupling parts substantially comprising a tongue and a groove extending generally parallel to said underside, said coupling parts further including integrated mechanical locking elements which prevent the drifting apart of coupled ones of said panels away from each other in directions perpendicular to the respective coupled side edges and parallel to the undersides of the panels, said coupling parts defining at least in part a lower lip which defines at least a portion of a lower side of each groove of the coupling parts and an upper lip located above each groove area adjacent the upper surface of the panel; said lower lip extending distally beyond the upper lip; said locking elements including a portion of said lower lip which slopes downwardly in a direction extending from a distally outer location towards a proximally inner location, said portion located at least in part on a part of the lower lip extending beyond said upper lip, a lower side of said tongue that is inclined downwardly in a direction extending from proximal inner location of said tongue to a distally outer location thereof; said portion of said lower lip that slopes downwardly cooperating with said lower side of the tongue that is inclined, said lower lip including an elastically bendable portion that must be elastically bent downwardly to enable coupling of a complementary pair of tongue and groove coupling parts; comprising the steps of:

laying a first one of said panels on a support surface;

coupling a second one of said panels to said first one panel along first and second complementary side edges of the panels by fitting a tongue of one panel into a complementary groove of the other panel until said downwardly sloping portion of said lower lip engages said downwardly inclined lower side of said tongue while bending the lower lip elastically in a downward direction; and

maintaining said lower lip in a bent condition after such coupling to effectively bias the sloped and inclined portions of the lower lip and tongue together and to produce a resultant biasing force maintaining the panels compressed against each other at the coupled side edges.

4. A method according to claim 3, wherein said second panel is coupled to the first panel by first fitting the tongue

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and groove into each other with the second panel angled upwardly with respect to the first panel and then subsequently angling down the second panel to bring the two panels into a coplanar relationship, and causing by said angling down that the bendable portion of the lower lip of the first panel is resiliently bent downwardly over a small distance.

5. The method according to claim 3, wherein the second panel is coupled to the first panel by first fitting the tongue and groove into each other, said fitting being carried out by shifting the second panel relative to the first panel with both panels in a substantially coplanar relationship, and causing by said shifting that the bendable portion of the lower lip of the first panel is deflected downwardly over a small distance.

6. The method according to claim 3, wherein said tongue, groove, lips and locking elements are provided on coupling parts located at opposed pairs of opposite side edges, said method comprising the additional step of:

coupling a third one of said panels to the first and second ones of said panels respectively along complementary third and fourth side edges of the panels that extend perpendicular to each other; and causing by said coupling that an elastically bendable portion of a lower lip of the last recited side edges is elastically deflected in a downward direction, the return force of the deflected portion of the lip providing the resultant biasing force maintaining the panels compressed against each other along said third and fourth side edges.

7. The method according to claim 6, wherein the coupling of the panels is created by the steps of:

coupling the third panel to the first panel by first fitting a tongue of the third panel into a complementary groove of the first panel with the third panel angled upwardly with respect to the first panel, then angling down the third panel so that the first and third panels are coplanar, and causing by said angling down that the bendable portion of the lower lip of the first panel is deflected downwardly over a small distance to provide a resilient biasing force urging said first and third panels together;

coupling the third panel to the second panel by first partially fitting a tongue of the third panel into a complementary groove of the second panel and then shifting the third panel toward the second panel with the second and third panels in a coplanar relationship to fully couple the respective tongue and groove of the third and second panels; said third and second panels being thereby located in a coplanar condition with the bendable portion of the lower lip of the second panel remaining in a downwardly deflected condition to provide a resilient biasing force urging the third and second panels together.

8. The method according to claim 6, wherein the coupling of the panels is created by the steps of:

coupling the third panel to the first panel by first fully coupling together a tongue and groove of the third and first panels by shifting the third panel relative to first panel with both panels in a coplanar relationship, said shifting causing a bendable portion of the lower lip of the first panel to become and remain deflected downwardly over a small distance while the panels are coupled; and

coupling the third panel to the second panel by coupling the tongue and groove of the respective third and second panels, said coupling being carried out by shifting the third panel relative to the second panel with the panels in a substantially coplanar relationship;

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causing the bendable portion of the lower lip of the second panel to become and remain deflected downwardly over a small distance while the third and second panels are coupled.

9. The method according to claim 3, including the step of laying all the panels over a flexible underlay, said flexible underlay accommodating the downwardly bent portions of the panel lips with the upper surfaces of the panels lying in a common plane.

10. A floor covering comprising

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges,

said panel further comprising generally complementary coupling parts located at both of the pairs of said side edges, said coupling parts comprising a tongue and a groove, said tongue and groove when coupled along adjacent side edges of two ones of said panel comprising integral mechanical locking elements, said coupling parts as well as said mechanical locking elements being integral and made in one piece with said core material, said coupling parts together with said locking elements arranged so as to enable a locking in a direction perpendicular to the plane of the floor covering as well as in a direction perpendicular to the coupled side edges and parallel to a plane including the panels that are coupled,

wherein said coupling parts and the mechanical locking elements of at least said second pair of opposite side edges are configured such that two identical ones of said floor panel are coupled by shifting them laterally towards each other in a substantial planar fashion, and wherein the locking elements of said second pair of opposite side edges provide a snap-together coupling providing a snap-action during the coupling of two panels by shifting them laterally towards each other, said snap action being delivered substantially by said core material;

wherein said locking elements comprise a recess located in a lower lip extending at least to a side edge and defining at least in part a lower side of said groove; and a protrusion provided at a lower side of said tongue;

wherein the panels at the side edge comprising the groove, of at least one of the side edge of both pairs of the side edges, include an upper lip above the groove, said upper lip defining at least in part an upper side of said groove, and said upper lip terminating at a distal outer end, wherein said lower lip extends distally beyond the distal outer end of the upper lip, and further wherein the recess is located in the lower lip in an area of the lower lip that is located at least partly beyond the distal outer end of the upper lip.

11. The floor covering according to claim 10, wherein the configuration of the tongue and the lower lip are such that a tongue of said panel becomes automatically lodged in the groove of another identical one of said panels by laterally moving the panels towards each other in approximately a plane including the panels during which the tongue is partially inserted into the groove before the lower lip is deformed.

12. The floor covering according to claim 11, wherein said panel becomes automatically lodged in the groove of another identical one of said panels by laterally moving the panels towards each other in approximately a plane includ-

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ing the panels starting from positions at which the panels are completely separated from each other.

13. The floor covering according to claim 10, wherein the first pair of side edges as well as the second pair of the side edges comprise coupling parts and locking elements including a lower lip extending beyond the upper lip.

14. The floor covering according to claim 10, wherein one pair of the side edges comprises coupling parts in the form of a tongue and a groove and wherein the locking elements of this pair of side edges are located completely inside the groove.

15. The floor covering according to claim 14, wherein the groove is formed by upper and lower lips, the upper lip and the lower lip bordering the groove are of equal length.

16. The floor covering according to claim 15, wherein said floor panels are elongated and the side edges having the upper lip and the lower lip of equal length is located at one of the short sides of the panels.

17. The floor covering according to claim 10, wherein the lower lip extends beyond the upper lip over a distance which is smaller than the thickness of the panel.

18. The floor covering according to claim 10, wherein at least one pair of the edges, the locking elements comprise inclined contact surfaces.

19. The floor covering according to claim 18, wherein the contact surfaces define a tangent line which in respect to the plane of the floor covering shows an inclination which is comprised between 30° and 70°.

20. The floor covering according to claim 11, wherein the locking elements comprise at least one contact surface which is perpendicular to the plane of the panels.

21. The floor covering according to claim 14, wherein one pair of the side edges comprises coupling parts in the form of a tongue and a groove and wherein the locking elements of this pair of side edges are located completely inside the groove; and wherein the locking elements comprise at least one contact surface which is perpendicular to the plane of the panels.

22. The floor covering according to claim 10, wherein said lower lip comprises an increasing thickness from the recess towards the innermost point of said groove.

23. A floor covering comprising

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges,

said panel further comprising generally complementary coupling parts located at both of the pairs of said side edges, said coupling parts comprising a tongue and a groove, said tongue and groove when coupled along adjacent side edges of two ones of said panel comprising integral mechanical locking elements, said coupling parts as well as said mechanical locking elements being integral and made in one piece with said core material, said coupling parts together with said locking elements arranged so as to enable a locking in a direction perpendicular to the plane of the floor covering as well as in a direction perpendicular to the coupled side edges and parallel to a plane including the panels that are coupled,

wherein said coupling parts and the mechanical locking elements of at least said second pair of opposite side edges are configured such that two identical ones of said floor panel are coupled by shifting them laterally towards each other in a substantial planar fashion, and wherein the locking elements of said second pair of opposite side edges provide a snap-together coupling

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providing a snap-action during the coupling of two panels by shifting them laterally towards each other, said snap action being delivered substantially by said core material;

at least one of said pairs of edges comprising a lower lip defining at least in part a bottom side of a groove of said coupling parts and extending distally beyond a respective groove opening, and wherein said locking elements comprise a protrusion extending from the lower side of a tongue of said pairs of edges and a cooperating recess in said lower lip, said protrusion and recess fitting together when ones of said panel are coupled by said tongue and groove;

wherein, when a complementary tongue and groove are coupled, said protrusion and recess meet each other at contiguous contact surfaces at a common plane of tangency that with respect to a common plane of the coupled panels is inclined inwardly from a distally outer area towards a distally inner area at an angle less than 90°.

24. The floor panel according to claim 23, wherein the angle is between 30–70°.

25. A floor covering comprising

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges,

said panel further comprising generally complementary coupling parts located at both of the pairs of said side edges, said coupling parts comprising a tongue and a groove, said tongue and groove when coupled along adjacent side edges of two ones of said panel comprising integral mechanical locking elements, said coupling parts as well as said mechanical locking elements being integral and made in one piece with said core material, said coupling parts together with said locking elements arranged so as to enable a locking in a direction perpendicular to the plane of the floor covering as well as in a direction perpendicular to the coupled side edges and parallel to a plane including the panels that are coupled,

wherein said coupling parts and the mechanical locking elements of at least said second pair of opposite side edges are configured such that two identical ones of said floor panel are coupled by shifting them laterally towards each other in a substantial planar fashion, and

wherein the locking elements of said second pair of opposite side edges provide a snap-together coupling providing a snap-action during the coupling of two panels by shifting them laterally towards each other, said snap action being delivered substantially by said core material;

at least one of said pairs of edges comprising a lower lip defining at least in part a bottom side of a groove of said coupling parts and extending distally beyond a respective groove opening, and wherein said locking elements comprise a protrusion extending from the lower side of a tongue of said pairs of edges and a cooperating recess in said lower lip, said protrusion and recess fitting together when ones of said panel are coupled by said tongue and groove;

said panel including an upper outer edge and wherein the protrusion and recess include engageable complementary contact surfaces located on radii (R1–R2) centered within a circle which extends within a radius of 3 mm around the upper outer edge of the panel.

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26. A method of assembling a floor covering comprising hard floor panels of rectangular shape, said panels each including complementary coupling parts at opposed side edges of the panels, said coupling parts arranged to cooperate with complementary coupling parts of another one of said panel, said coupling parts comprising substantially a tongue, a groove, and integrated locking elements collectively arranged to prevent the drifting apart of two coupled ones of said floor panel in a direction parallel to the edges along which the panels are coupled and parallel to a plane including the floor panels, said panels each including distally extending upper and lower lips on opposite sides of said groove, said lower lip including an elastically flexible portion and defining at least in part a lower side of the groove and extending distally beyond the upper lip, and wherein one of said locking elements comprises at least in part a portion of the elastically flexible portion of the lower lip that extends beyond the upper lip and which is inclined downwardly in a direction extending inwardly from the distal end area of said lip, said locking element cooperating with a surface of the lower side of the tongue which slopes downwardly in a direction extending outwardly from a proximal area of the tongue toward a distal area thereof, said method comprising the steps of:

laying a first one of said hard floor panel on a support surface;

placing a second one of said panel next to a side edge of the first one of said panel, such that a tongue of one of said panel side edges lies next to a groove of the other one of said panel side edges;

shifting the panels towards each other to move a tongue into a groove and to bend a flexible portion of a lower lip downwardly, said shifting causing the inclined and sloped surfaces of the tongue and groove respectively to engage each other in coupled relationship with the panels biased towards each other by the returning force of the downwardly bent lower lip;

wherein a third panel is coupled to a previously laid one or more of said first and second ones of said panel by placing the tongue of the third panel in a complementary groove of one or more of the previously laid panels, and wherein the second one of said panel, before being coupled with the first one of said panel, is coupled to an already previously laid one or more of said panel using the steps of:

directing a tongue of the third one of said panel towards a groove of an already laid panel or panels and inserting a tongue of the third one of said panel at least partially into the groove of an already laid panel or panels while the third one panel is angled upwardly relative to the already laid panel or panels; angling down the third one of said panel so that the inclined locking elements are brought adjacent each other;

after such angling down of the third one of said panel, laterally moving the third one of said panel towards the previously laid one or more panels with the panels in a common plane to completely engage the tongue, groove and locking elements of the third one of said panel with a complementary tongue, groove and locking element of the previously laid panel or panels.

27. A floor covering comprising

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibre-

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board (MDF), said panel comprising a first pair and a second pair of opposed side edges,
said panel further comprising generally complementary coupling parts located at both of the pairs of said side edges, said coupling parts comprising a tongue and a groove, said tongue and groove when coupled along adjacent side edges of two ones of said panel comprising integral mechanical locking elements, said coupling parts as well as said mechanical locking elements being integral and made in one piece with said core material,
said coupling parts together with said locking elements arranged so as to enable a locking in a direction perpendicular to the plane of the floor covering as well as in a direction perpendicular to the coupled side edges and parallel to a plane including the panels that are coupled,
wherein said coupling parts and the mechanical locking elements of at least said second pair of opposite side edges are configured such that two identical ones of said floor panel are coupled by shifting them laterally towards each other in a substantial planar fashion, and
wherein the locking elements of said second pair of opposite side edges provide a snap-together coupling providing a snap-action during the coupling of two panels by shifting them laterally towards each other,

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said snap action being delivered substantially by said core material;
wherein said coupling parts and locking elements of the first pair of side edges are configured and dimensioned so as to enable two identical ones of said floor panel to be coupled at the side edges at least by turning one of said floor panels relative to the other.
28. The floor covering according to claim 27, wherein said coupling parts and locking elements of the first pair of side edges are configured and dimensioned so as to enable identical ones of said floor panel to be laterally coupled at these side edges exclusively by turning one of said floor panels relative to the other.
29. The floor covering according to claim 27, wherein said floor panels are elongated and the first pair of opposed side edges is formed by the longer side edges, whereas the second pair of opposed side edges is formed by the shorter side edges.
30. The floor covering according to claim 27, wherein said coupling parts and said locking elements of both of the pairs of side edges are configured and dimensioned so as to enable identical ones of said floor panel to be laterally engaged, as well as disengaged, at their side edges by turning one of said floor panel relative to the other.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,490,836 B1
DATED : December 10, 2002
INVENTOR(S) : Moriau et al.

Page 1 of 7

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

The title page showing the illustrative figure should be deleted, and substituted therefore the new title page with the illustrated figure attached.

Drawings,

The drawing sheets 1-4 & 9, consisting of figures 3, 5, 8, 11, 22 & 23, should be deleted to be replaced with the drawing sheets 1-4 & 9, consisting of figures 3, 5, 8, 11, 22 & 23, as shown on the attached sheets.

Signed and Sealed this

Twenty-fourth Day of June, 2003

A handwritten signature in black ink, appearing to read "James E. Rogan", with a long horizontal flourish underneath.

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

(12) **United States Patent**
Moriau et al.(10) **Patent No.:** **US 6,490,836 B1**
(45) **Date of Patent:** ***Dec. 10, 2002**

- (54) **FLOOR PANEL WITH EDGE CONNECTORS**
- (75) Inventors: **Stefan Simon Gustaaf Moriau**, Ghent (BE); **Mark Gaston Maurits Cappelle**, Staden (BE); **Bernard Paul Joseph Thiers**, Oostrozbeke (BE)
- (73) Assignee: **Unilin Beheer B.V. Besloten Vennootschap**, Nieuwerkerk A/D IJssel (NL)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

- (21) Appl. No.: **09/471,014**
- (22) Filed: **Dec. 23, 1999**

Related U.S. Application Data

- (63) Continuation of application No. 08/872,044, filed on Jun. 10, 1997, now Pat. No. 6,006,486.

(30) **Foreign Application Priority Data**

Jun. 11, 1996 (BE) 09600527
Apr. 15, 1997 (BE) 09700344

- (51) Int. Cl.⁷ **E04B 2/08**
- (52) U.S. Cl. **52/589.1; 52/592.1; 52/586.1; 52/590.2; 52/592.3**
- (58) Field of Search **52/578.1, 589.1, 52/592.1, 590.2, 592.7, 586.1, 570, 572, 591.1, 590.1**

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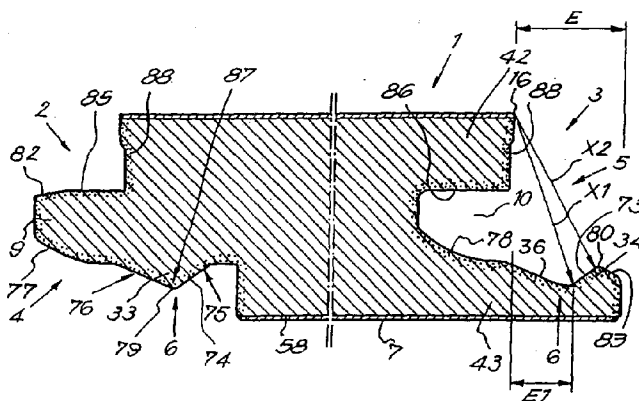
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(List continued on next page.)

Primary Examiner—Yvonne M. Horton(74) *Attorney, Agent, or Firm*—Bacon & Thomas(57) **ABSTRACT**

Floor covering, including hard floor panels (1) which, at least at the edges of two opposite sides (2-3, 26-27), are provided with coupling parts (4-5, 28-29), cooperating with each other, substantially in the form of a tongue (9-31) and a groove (10-32), wherein the coupling parts (4-5, 28-29) are provided with integrated mechanical locking elements (6) which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges (2-3, 26-27) and parallel to the underside (7) of the coupled floor panels (1).

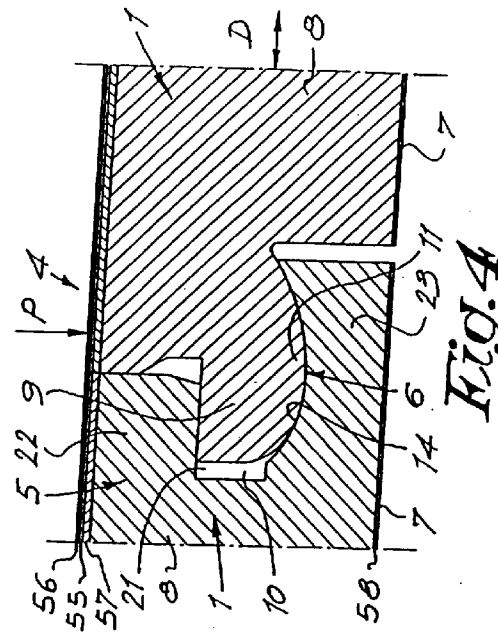
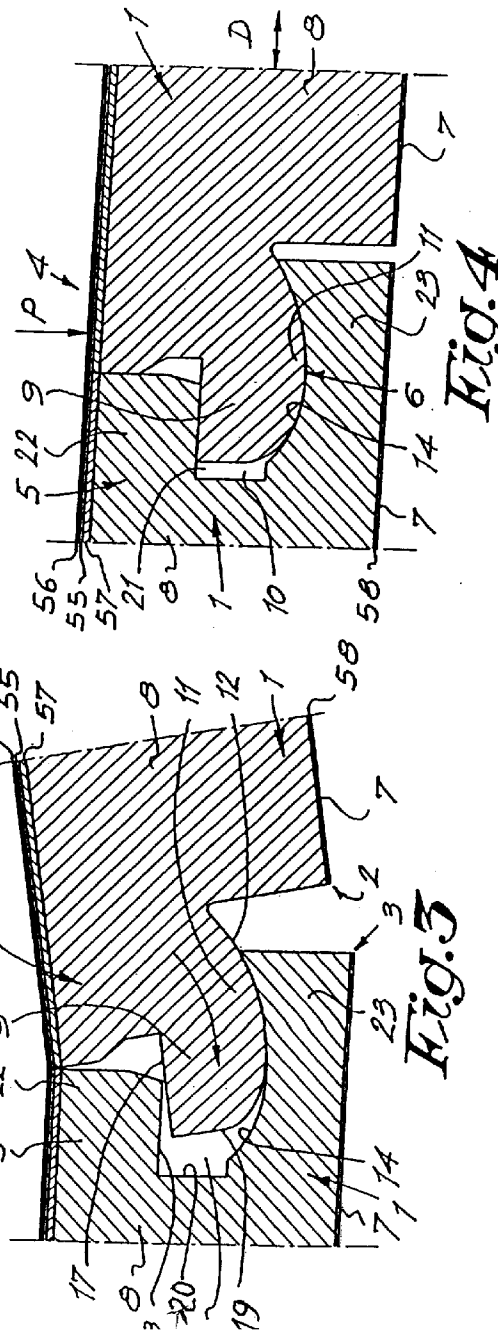
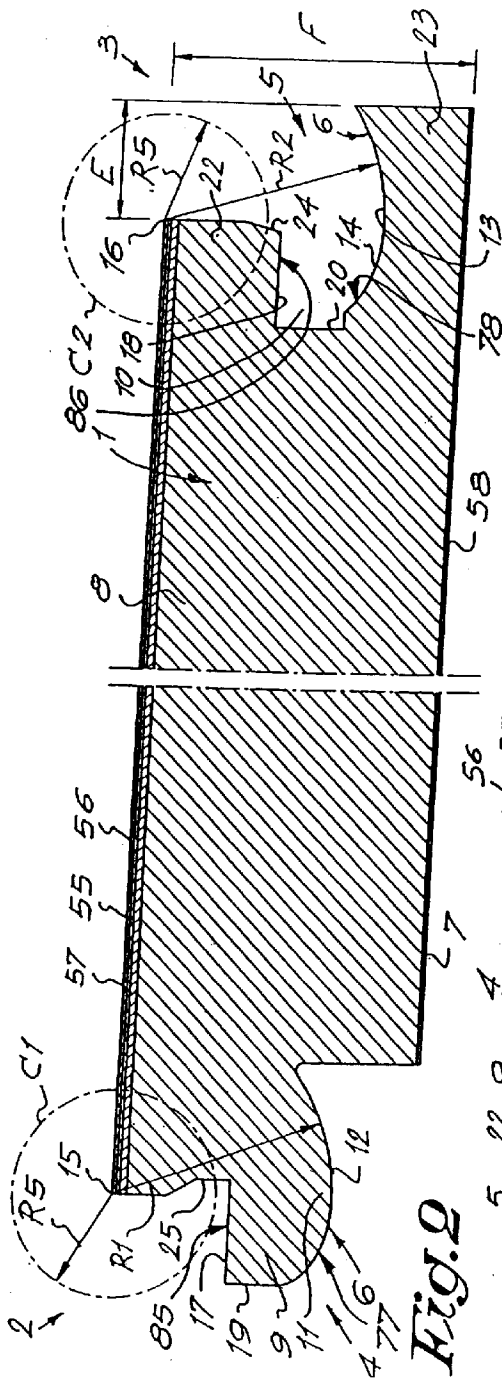
30 Claims, 10 Drawing Sheets

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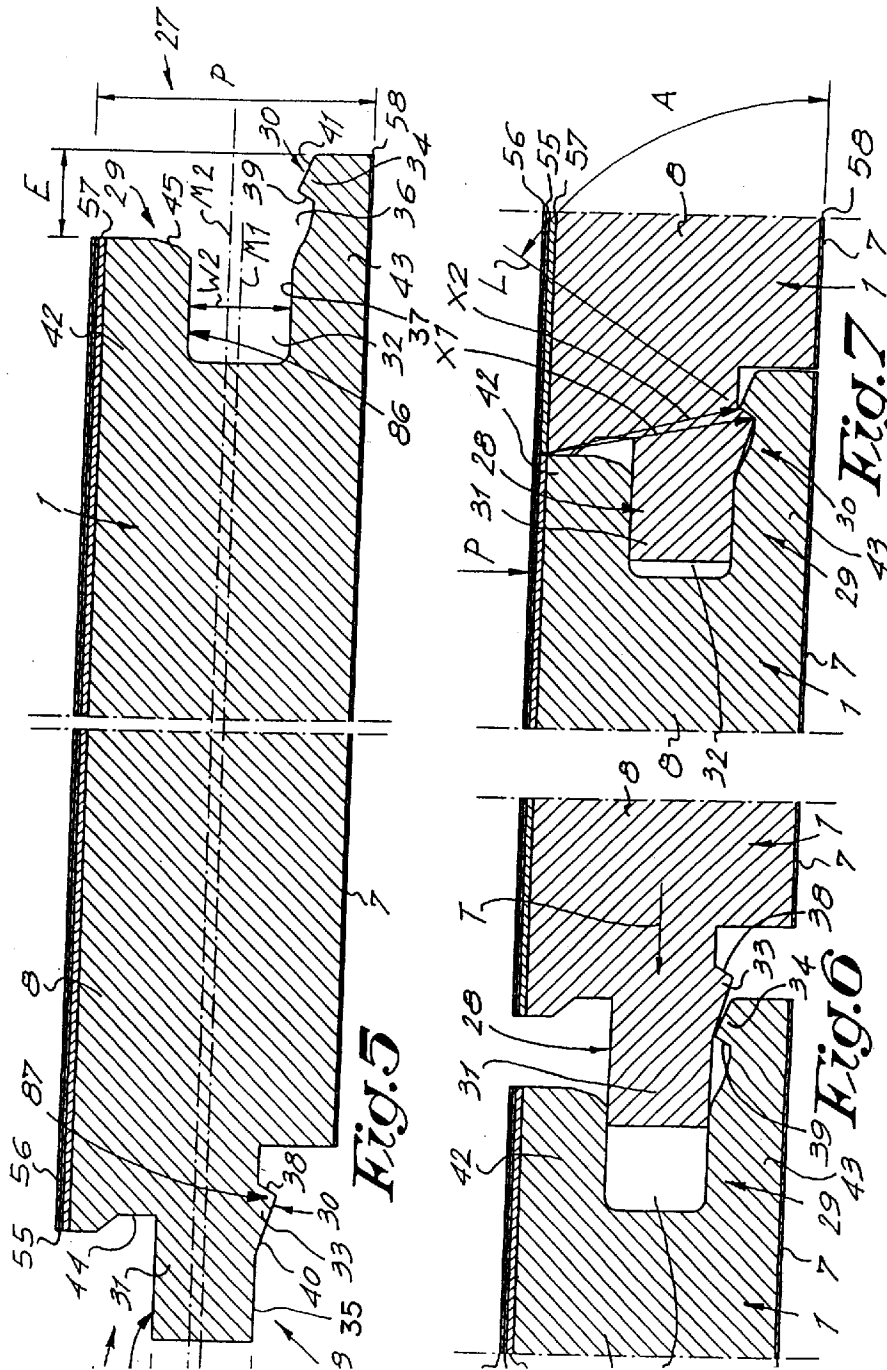


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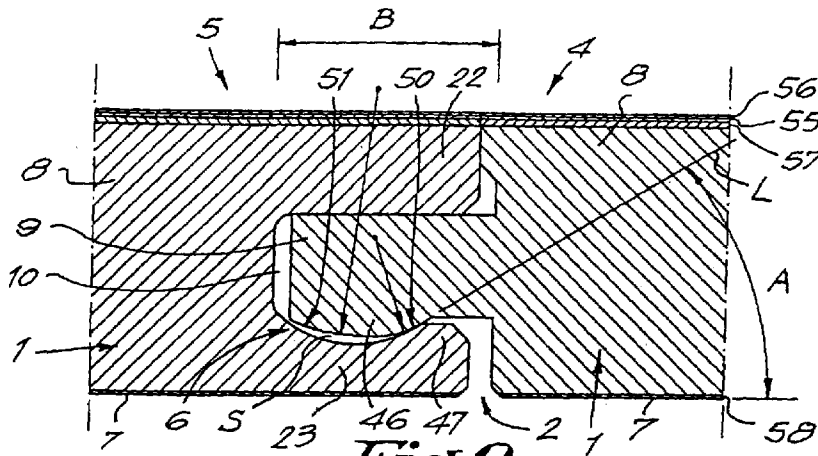


Fig. 9

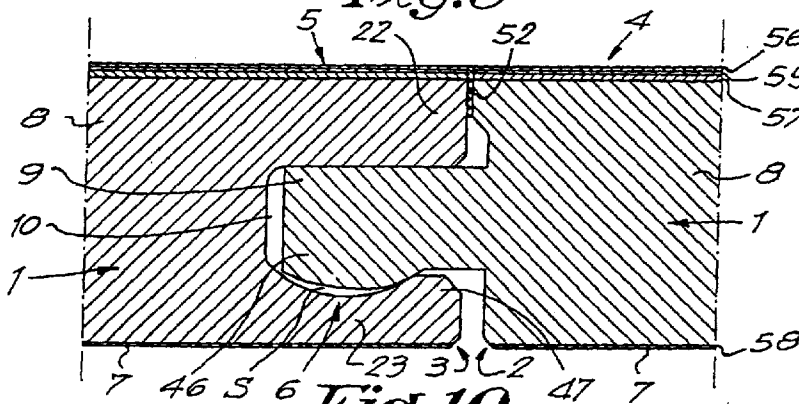


Fig. 10

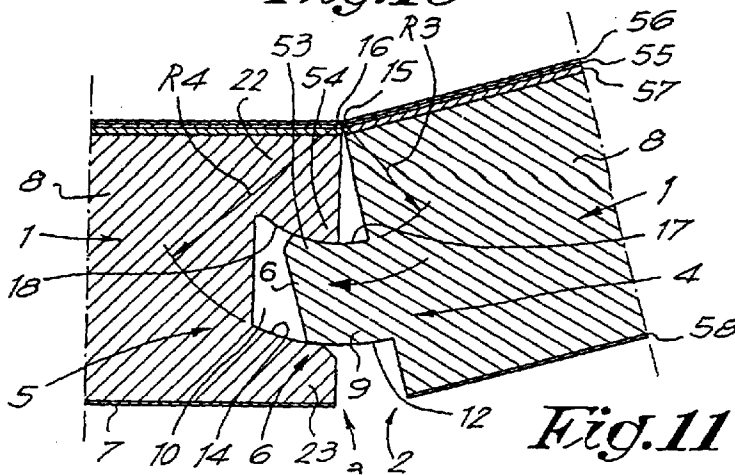


Fig. 11

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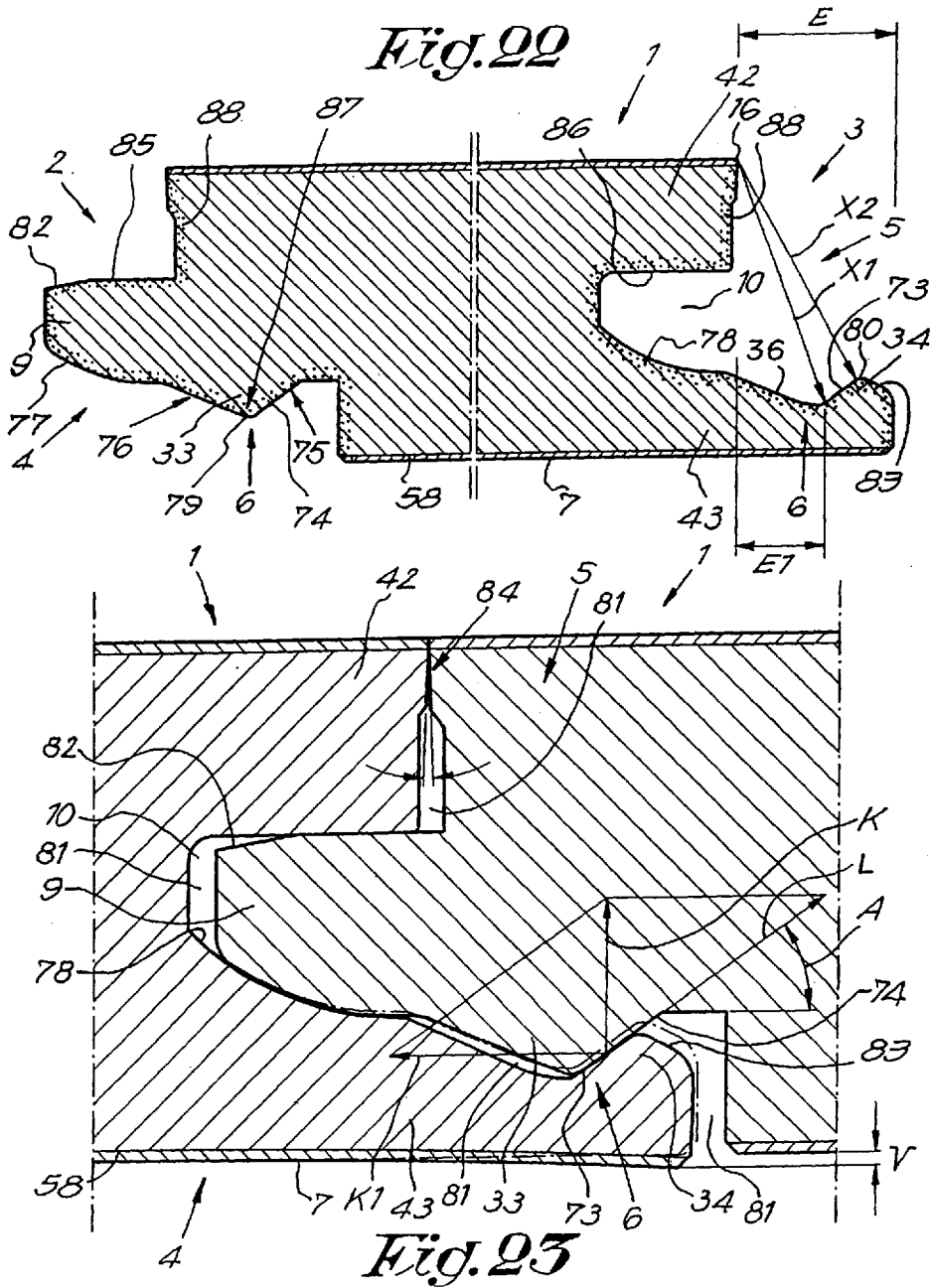


EXHIBIT C

(12) **United States Patent**
Moriau et al.

(10) **Patent No.:** **US 6,874,292 B2**
(45) **Date of Patent:** **Apr. 5, 2005**

(54) **FLOOR PANELS WITH EDGE CONNECTORS**

(75) Inventors: **Stefan Simon Gustaaf Moriau**, Gent (BE); **Mark Gaston Maurits Cappelle**, Staden (BE); **Bernard Paul Joseph Thiers**, Oostrozebeke (BE)

(73) Assignee: **Unilin Beheer BV**, Besloten Vennootschap, IJssel (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/266,667**

(22) Filed: **Oct. 9, 2002**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 09/471,014, filed on Dec. 23, 1999, now Pat. No. 6,490,836, which is a continuation of application No. 08/872,044, filed on Jun. 10, 1997, now Pat. No. 6,006,486.

(30) **Foreign Application Priority Data**

Jun. 11, 1996 (BE) 9600527
Apr. 15, 1997 (BE) 9700344

(51) **Int. Cl.**⁷ **E04B 2/08**

(52) **U.S. Cl.** **52/590.2**; 52/586.1; 52/589.1; 52/592.1; 52/592.3

(58) **Field of Search** 52/586.1, 589.1, 52/592.1, 592.3

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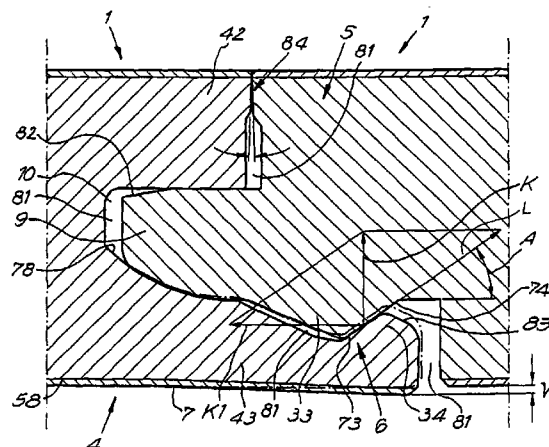
Assistant Examiner—Yvonne M. Horton

(74) *Attorney, Agent, or Firm*—Bacon & Thomas, PLLC

(57) **ABSTRACT**

Floor covering, including hard floor panels which, at least at the edges of two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges and parallel to the underside of the coupled floor panels, and provide a snap-action coupling.

6 Claims, 10 Drawing Sheets



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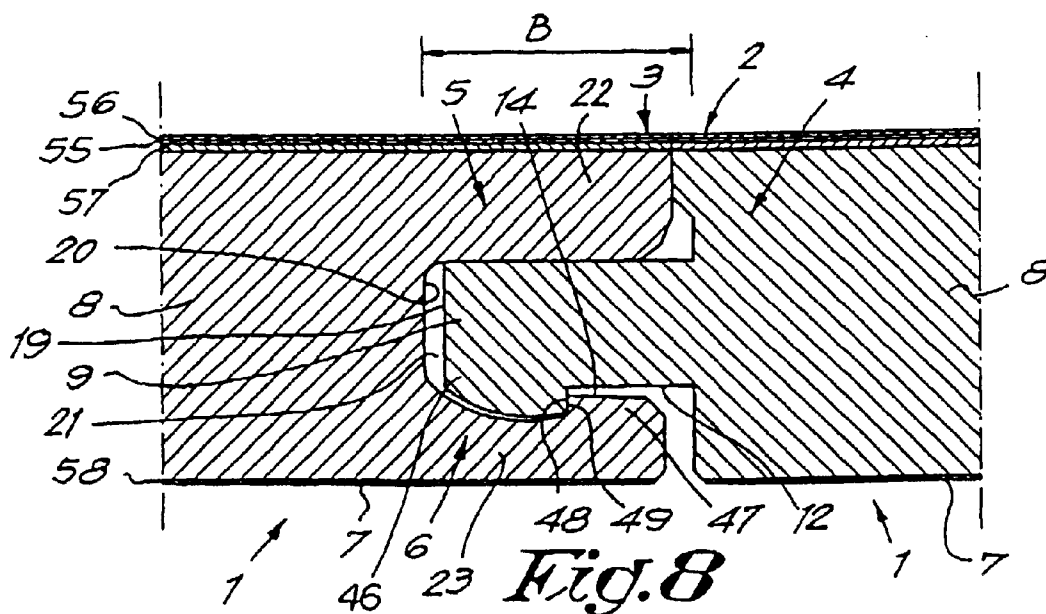
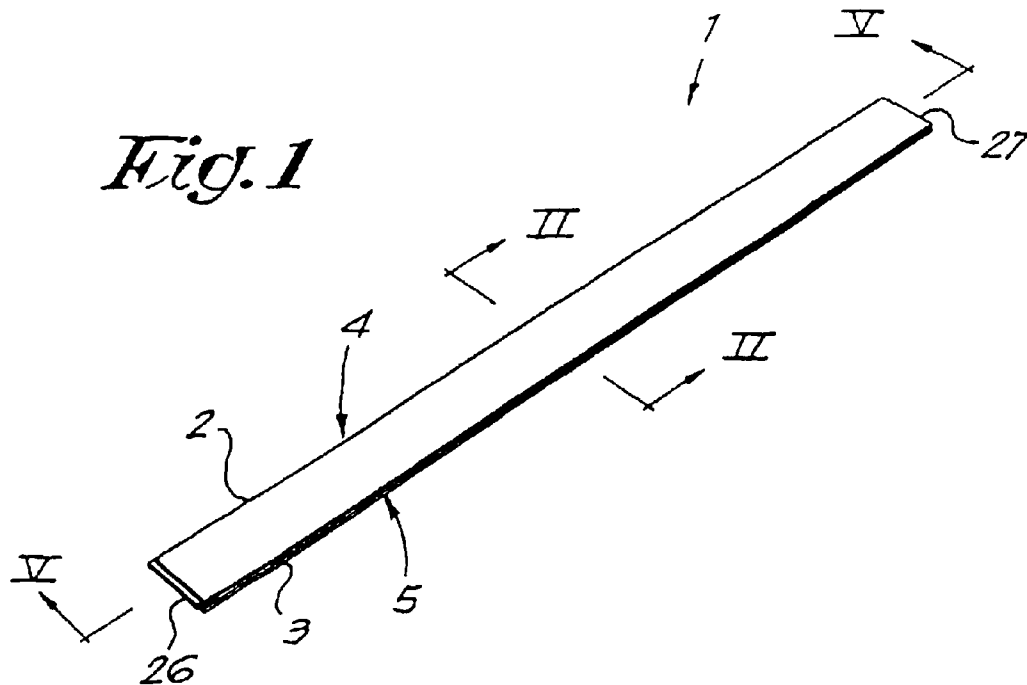
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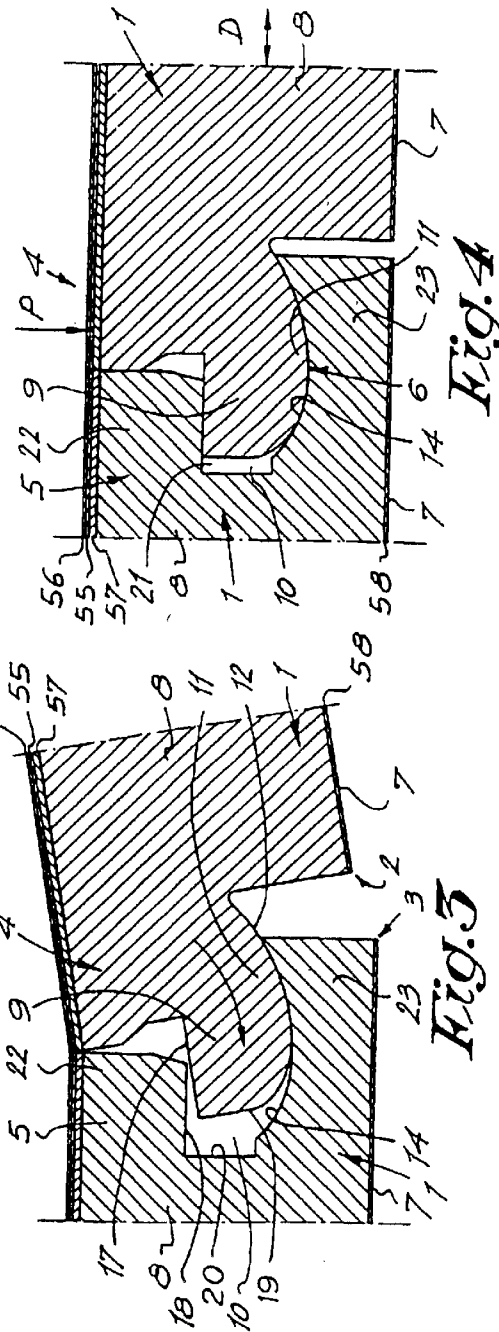
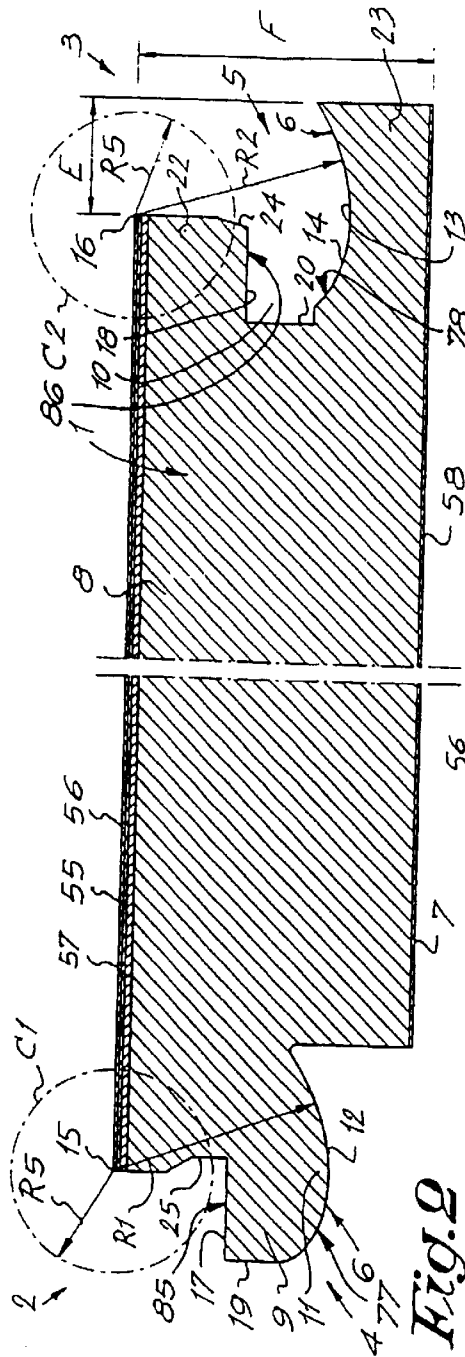
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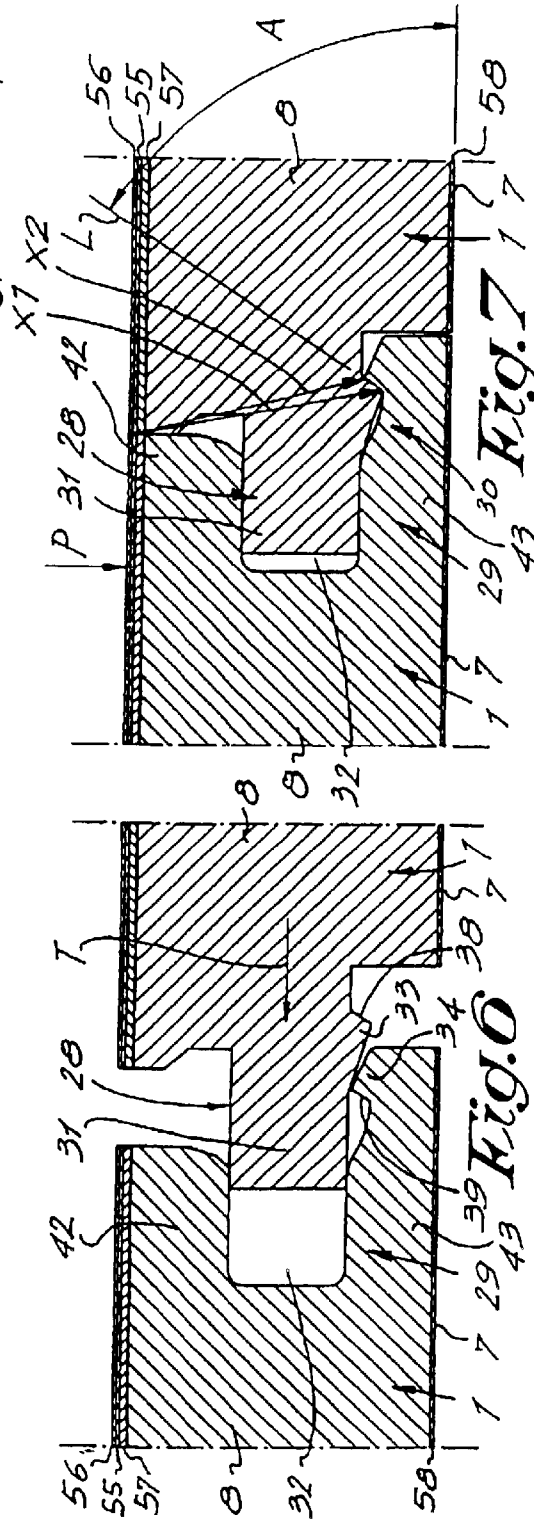
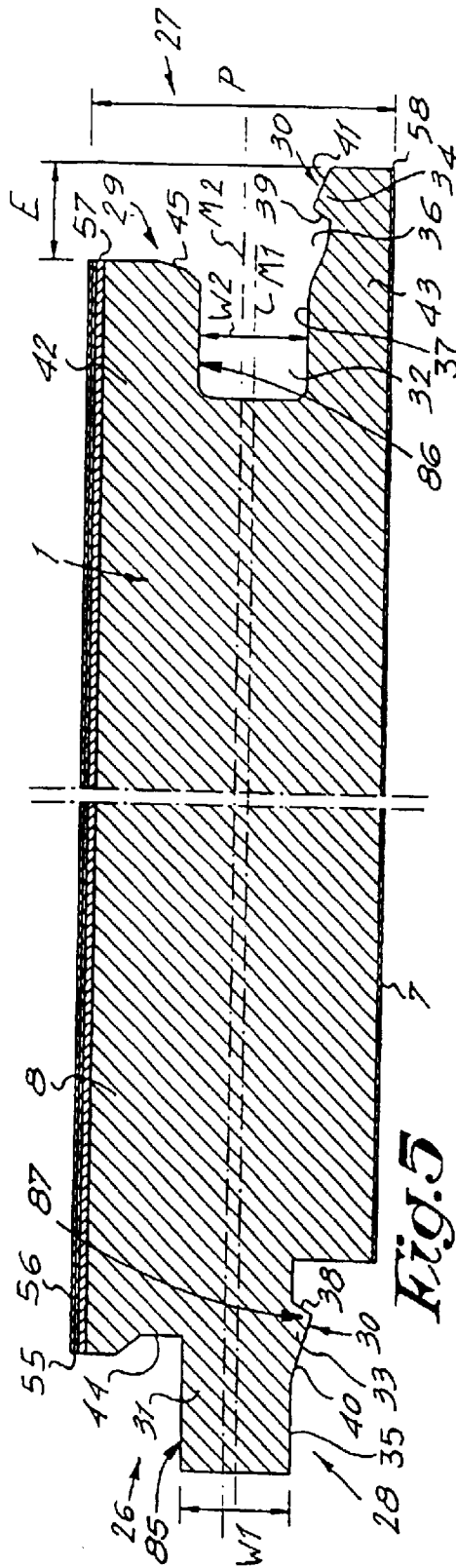
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Fig. 1







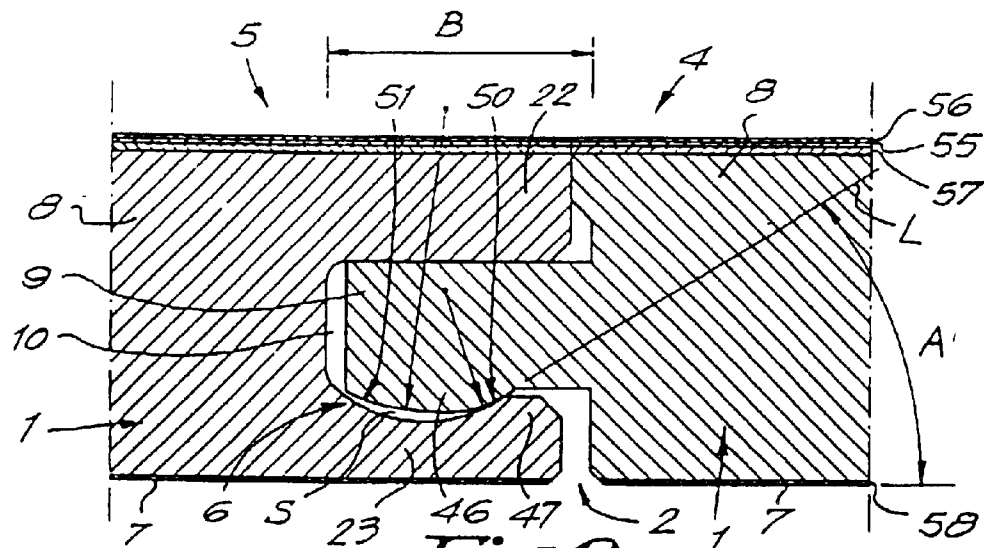


Fig. 9

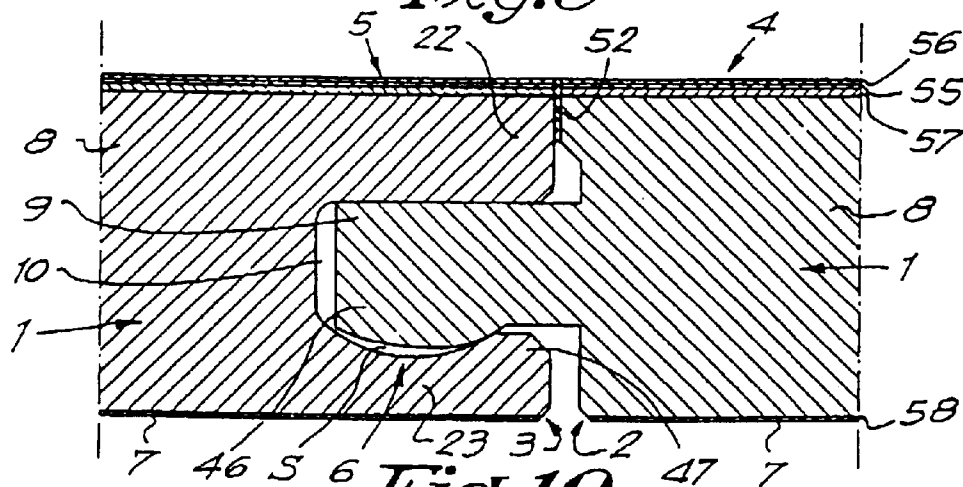


Fig. 10

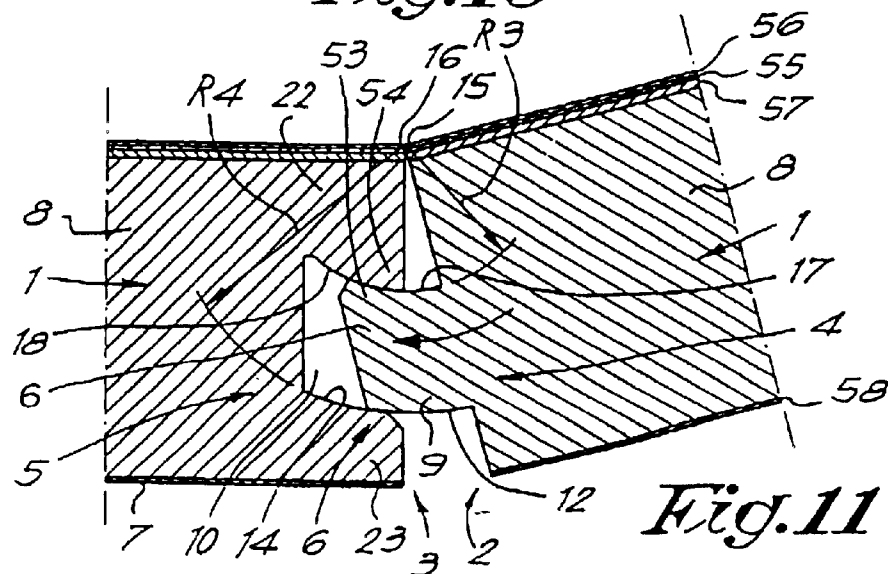


Fig. 11

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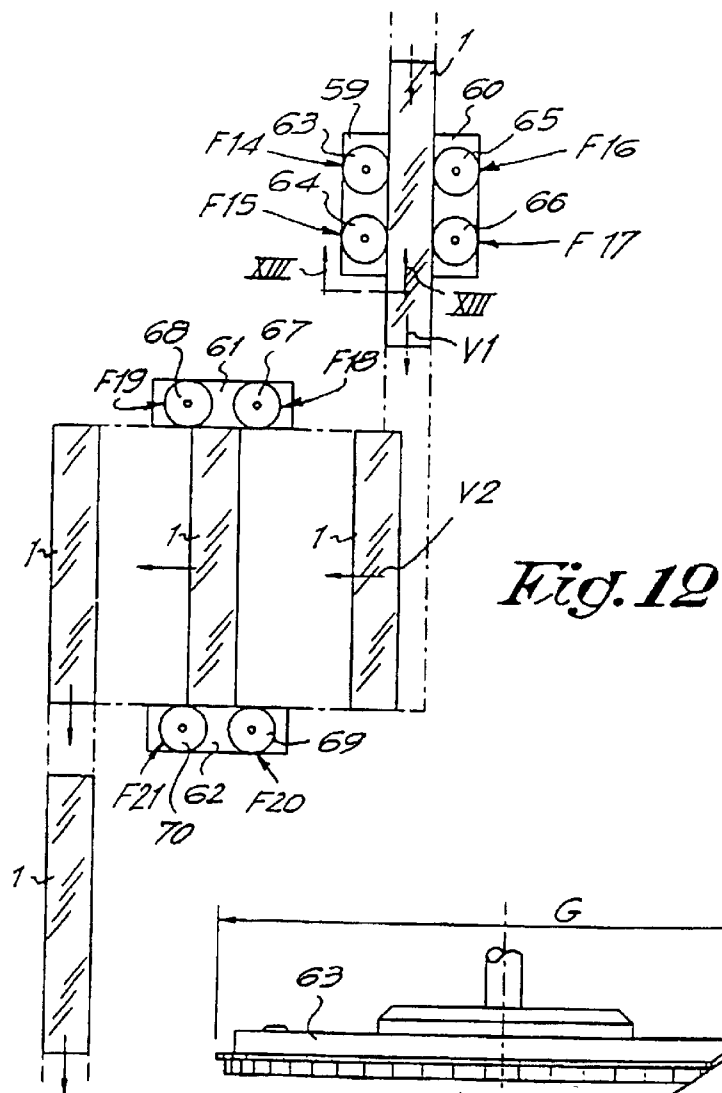


Fig. 12

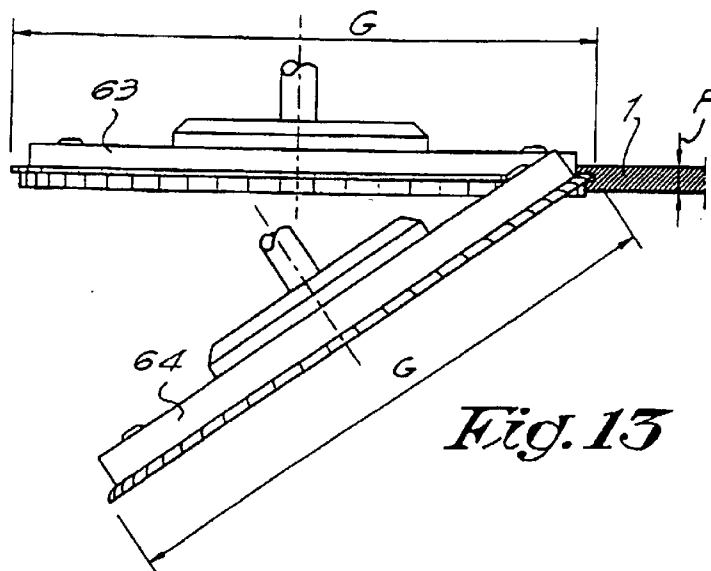


Fig. 13

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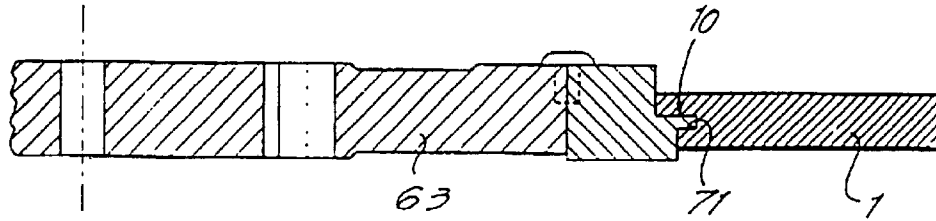


Fig. 14

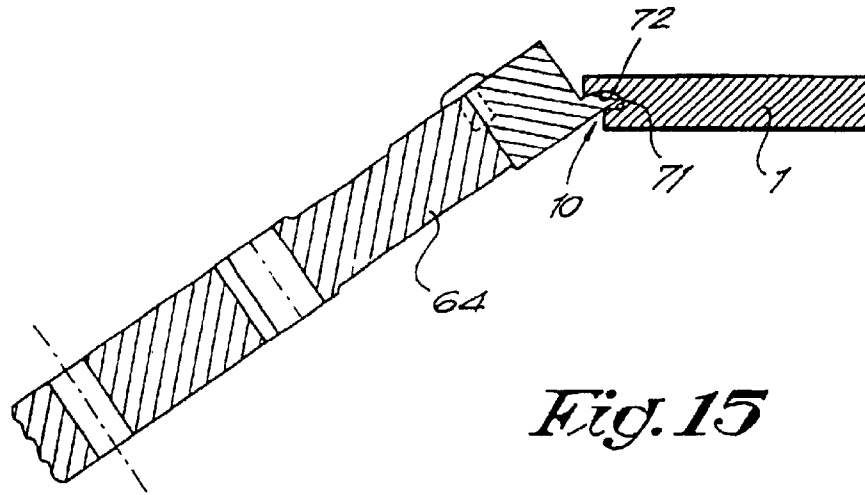


Fig. 15

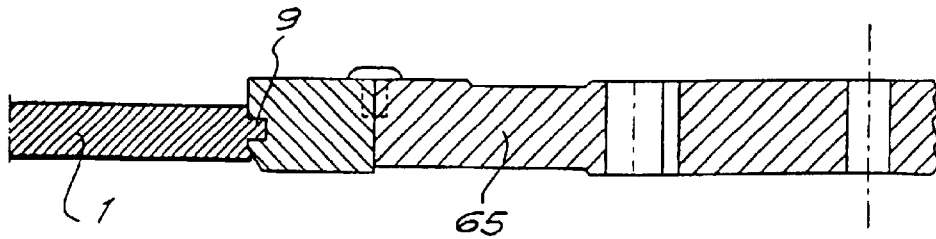


Fig. 16

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Fig. 17

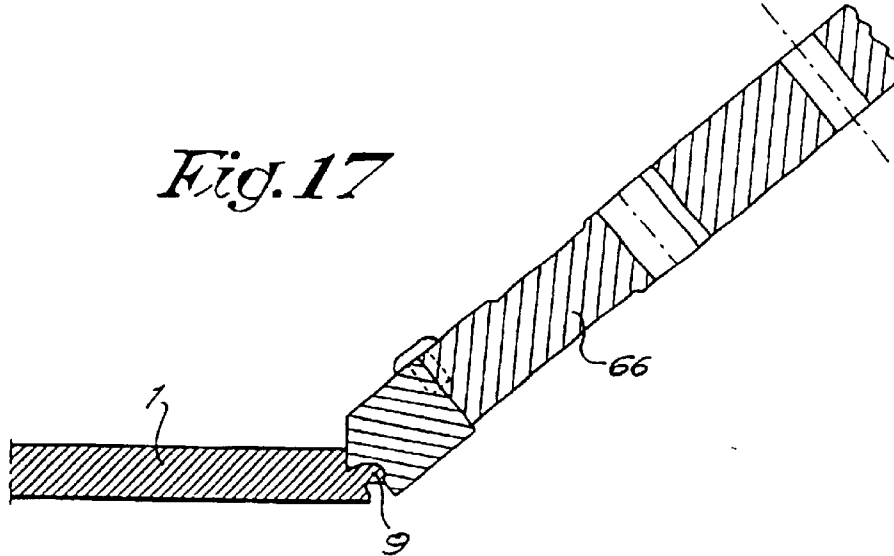


Fig. 18

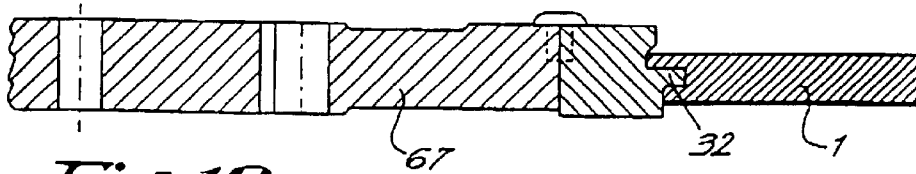
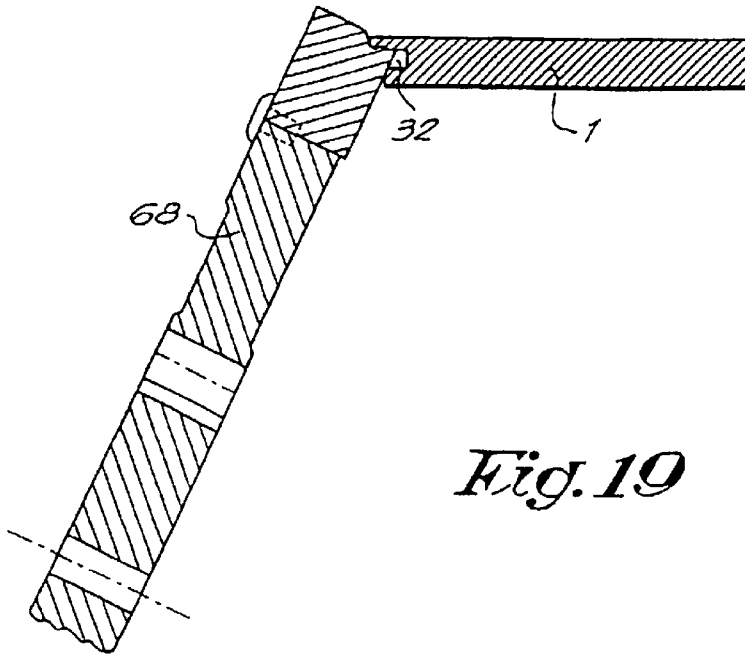


Fig. 19



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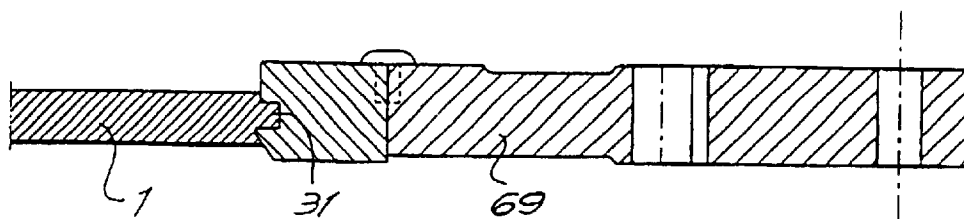


Fig. 20

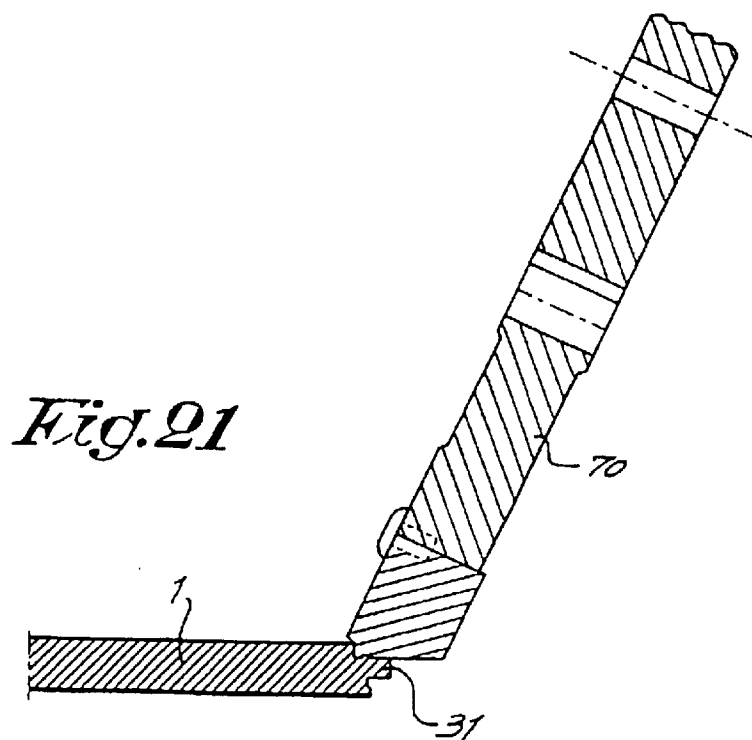
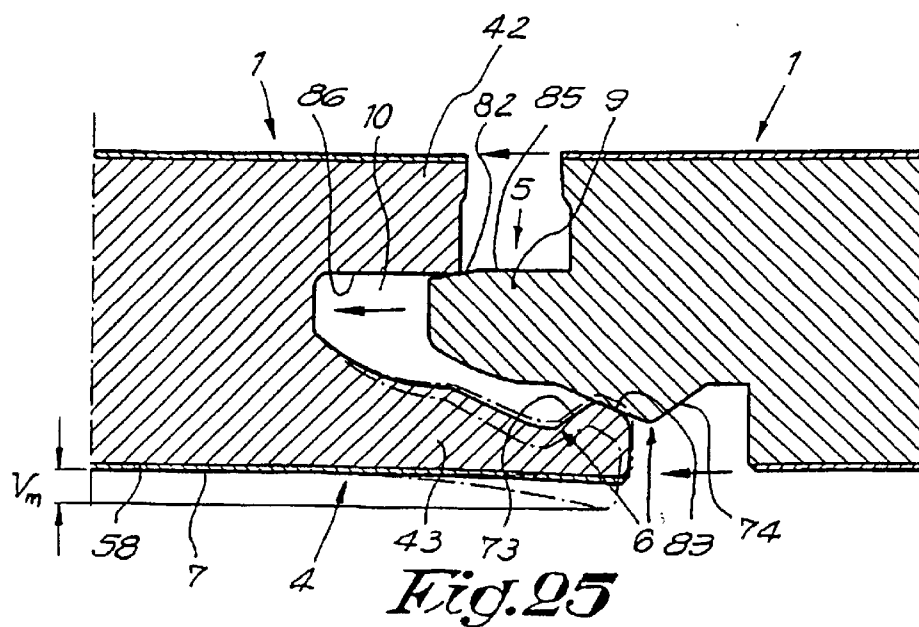
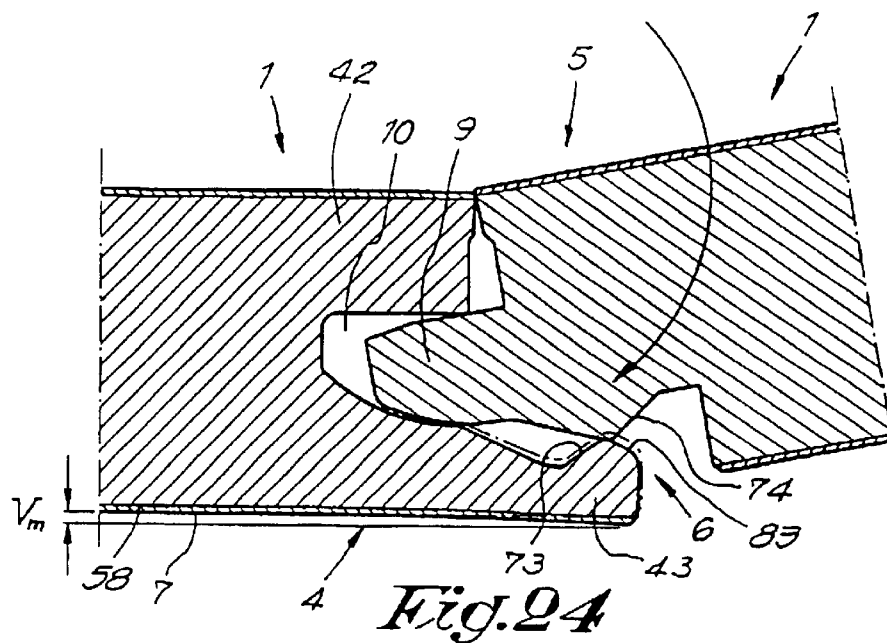


Fig. 21



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FLOOR PANELS WITH EDGE CONNECTORS**RELATED APPLICATION DATA**

This application is a continuation of U.S. patent application Ser. No. 09/471,014, filed Dec. 23, 1999, now U.S. Pat. No. 6,490,836; which is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997, now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION**1. Field of the Invention**

This invention relates to a floor covering made of hard floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

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Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are

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formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles (fibers) and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is

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avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. 1 represents a floor panel of a floor covering according to the invention;

FIG. 2, on a larger scale, represents a cross-section according to line II—II in FIG. 1;

FIGS. 3 and 4 represent how two floor panels with coupling parts according to FIG. 2 match into each other;

FIG. 5, on a larger scale, represents a cross-section according to line V—V in FIG. 1;

FIGS. 6 and 7 represent how two floor panels with coupling parts according to FIG. 5 match into each other;

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FIGS. 8 to 11 represent a number of variants of coupling parts of floor panels according to the invention;

FIG. 12 schematically represents how the floor parts can be provided with coupling parts;

FIG. 13 represents a cross-section according to line XIII—XIII in FIG. 12;

FIGS. 14 to 21, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. 12 with arrows F14 to F21;

FIG. 22 represents a floor panel according to the invention;

FIG. 23, on a larger scale, represents the coupling of two floor panels of FIG. 22;

FIGS. 24 and 25 represent two manners of coupling floor panels according to FIG. 22 to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels 1, for example, such as a laminated panel as shown in FIG. 1.

These floor panels 1 can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. 1, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is, at least at the edges of two opposite sides 2-3, provided with coupling parts 4-5 which permit two adjacent identical floor panels 1 to be coupled to each other.

According to the invention, the coupling parts 4-5, as represented in the FIGS. 2 to 4, are provided with integrated mechanical locking parts or locking elements 6 which prevent the drifting or sliding apart of two coupled floor panels 1 in a direction D perpendicular to the respective sides 2-3 and parallel to the underside 7 of the coupled floor panels 1; the coupling parts 4-5 and the locking elements 6 are formed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two subsequent floor panels 1 can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel 1 can be laterally inserted into the previous; and the coupling parts 4-5 preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels 1 with an elongated shape, as represented in FIG. 1, the respective coupling parts 4-5 are located at the longitudinal sides 2-3.

The coupling parts 4-5 can be realized in various forms, although the basic forms thereof will always be formed by a tongue 9 and a groove 10.

In the form of embodiment of FIGS. 2 to 4, the related floor panel 1 is provided with coupling parts 4-5 and locking means or locking elements 6 which allow two floor panels 1 to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements 6 consist of a first locking element 11, formed by a protrusion with a bent round shape at the lower side 12 of the tongue 9, and a second locking element 13 (shown in FIG. 2), formed by a recess with a bent hollow or downwardly concave shape in the lower wall 14 of the groove 10.

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The locking elements 11-13 ensure that two floor panels 1 which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels 1 to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side 12 of locking means or locking elements 6 has a curvature with a radius R1, the center of which coincides with the respective upper edge 15 of the floor panel 1, whereas the lower wall 14 of the locking part 5 has a curvature with a radius R2 which is equal to the radius R1, but its center coincides with the respective upper edge 16. Radii R1 and R2 may also be applied which are larger or smaller than the distance to the upper edge 15, 16 respectively, and/or which differ from each other in size.

The upper side 17 of the tongue 9 and the upper wall or side 18 of the groove 10 are preferably flat and preferably are located in the horizontal plane.

The inner side 20 of the groove 10 and the front side 19 of the tongue 9 of the two interlocked floor panels 1 preferably do not fit closely against each other, such that an intermediate space 21 is created between them into which possible dust remainders or such can be pushed away by means of the tongue 9.

The tongue 9 and the groove 10 preferably have shapes which are complementary to each other, such that the tongue 9 in the engaged condition of two identical floor panels 1 precisely sits against the upper wall 18 and the lower wall 14 of the groove 10, whereby a pressure P, exerted against the upper lip 22, is received or reacted not only by this lip 22, but by the complete structure, because this pressure can be transmitted through the tongue 9 and the lower lip 23 to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer 24 on lip 22 and a recess 25 can be provided, as represented in FIGS. 2 to 4, as a result of which the subsequent floor panels 1 can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. 5 to 7, the floor panels 1 according to the invention can also, along the sides 26-27 which are at a right angle to the sides 2-3, be provided with coupling parts 28-29 which have locking elements 30, too. The coupling parts 28-29 are preferably also realized in the shape of a tongue 31 and a groove 32. Hereby, the locking elements 30 do not have to be of the same nature as the locking elements 6.

Preferably, at the sides 26-27 locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. 6 and 7. To this aim, the locking elements 30 consist of a snap-together connection with locking elements 33 and 34 which grip behind each other.

As represented in FIGS. 5 to 7, the locking element 33 preferably consists of a protrusion of the lower side 35 of the tongue 31 which can be located in a recess 36 in a lower lip 43 extending distally from the lower wall 37 of the groove 32. The locking element 34 is formed by the upward directed part or protrusion which defines the distally outer end of recess 36.

In this case, the locking elements 33-34 have contact surfaces 38-39 which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The

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common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces 38–39, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside 7, which angle is smaller than 90°.

The locking elements 33–34 preferably are provided with inclined portions 40 and 41 which, when two floor panels 1 are engaged, cooperate with each other in such a manner that the locking elements 33–34 can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. 6 and 7).

The thickness W1 of the tongue 31 preferably is equal to the width W2 of the groove 32, such that compression pressure P applied to the upper lip 42 is reacted by the tongue 31 which, in its turn, then is reacted by the lower lip 43.

Analogous to the chamfer 24 and recess 25, a recess 44 and a chamfer 45 are provided also at the edges 28–29.

It is noted that such a snap-together coupling can also be applied at the edges 2–3. Hereby, this can be a snap-together coupling analogous to these of FIGS. 5 to 7, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. 8 and 9. Contrary to the locking elements 33–34 which consist of rather local protrusions, in the forms of embodiment of FIGS. 8 and 9 use is made of locking elements 46–47 which, in comparison to the total width B of the coupling, extend over a rather large distance.

In this case, the locking elements 46–47 are also provided at the lower side 12 of the tongue 9 and the lower wall 14 of the groove 10.

According to FIG. 8, the locking elements 46–47 have contact surfaces 48–49 which are at an angle with the plane of the floor panel 1. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. 9, the locking elements 46–47 possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements 46–47 hereby consist of curved surfaces. The common plane of tangency L forms an angle A which is smaller than 90°, and more preferably is smaller than 70°.

In this manner, the locking element 46 preferably has two portions with a different curvature, on one hand, a portion 50 with a strong curvature and, on the other hand, a portion 51 with a weak curvature. The portion 50 with the strong curvature provides for the formation of a firm coupling. The portion 51 with the weak curvature facilitates the coupling parts 4–5 to be brought into each other easily. The intermediate space S forms a chamber which offers space for dust and the like which, when engaging two floor panels 1, inevitably infiltrates there.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. 7 to 9, preferably the tongue 9–31 has a shape that thickens from below, which then can cooperate with a widened portion in the groove 10.

In FIG. 10, a variant is represented whereby at least at the level of the upper edges 15–16, a sealing material 52 is provided, as a result of which a watertight sealing can be assured. This sealing material 52 may consist of a strip or covering which is provided previously at the floor panel 1, either at one or both upperside edges 15–16.

In FIG. 11, a further variant is represented, whereby the locking element 6 is formed by an upward directed portion

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53 at the tongue 9, which as a result of a turning movement of the panel, is brought behind a downward-directed portion 54 on the upper wall 18. More particularly, this is obtained by forming the upper side 17 and the upper wall 18 with a curvature R3, the center of which is situated at the upperside edges 15–16, and forming the lower side 12 and the lower wall 14 with a radius R4, the center of which is also situated at the upperside edges 15 and 16, respectively. These radii R3–R4 can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius R1, R3 respectively, and, on the other hand, the radius R2, R4 respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle C1, C2 (see FIG. 2) respectively, which extends with a radius R5 of 3 mm centered at upperside edge 15, 16 respectively.

Finally is noted that, according to the invention, the lower lip 23–43, as represented in FIGS. 2 to 7, can be formed distally longer than the upper lip 22–42. This has an advantage that the coupling parts 4–5–28–29 can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels 1, because each subsequent floor panel 1 during installation can be placed upon the protruding lower lip 23–43, as a result of which the tongue 9–31 and the groove 10–32 automatically are positioned in front of each other.

The embodiments wherein the lower lip 23 is equal to or distally shorter than the upper lip 22, in their turn, offer the advantage that no protruding lip 23 remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference E between the distally outer edge of the upper lip 22–42 and the distally outer edge of the lower lip 23–43, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove 10, should preferably be kept smaller than one time the total thickness F of the floor panel 1. For stability's sake, normally this total thickness F shall never be less than 5 mm.

The small dimension of the difference E offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line M1 through the tongue 9 and the groove 10 is situated lower than the center line M2 of the floor panel 1, such, that the upper lip 22–42 is thicker than the lower lip 23–43. In first instance, this is essential in this kind of connection, because then it is the lower lip 23–43 which bends, whereby the upper side of the floor panel 1 is kept free of possible deformations.

As explained in the introduction, for the core 8 a material is chosen from the following series:

- a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;
- a product based on synthetic material;
- chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. 2 to 11, such laminated flooring preferably consists of a core 8 made of MDF medium density fiberboard board, HDF high density

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fiberboard board or similar, whereby at least at the upper side of this core 8 one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer 55 and a protective top layer 56. The decorative layer 55 is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer 56 preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer 57 upon which the decorative layer 55 is provided.

Preferably, also a backing layer 58 shall be applied at the underside 7, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel 1. This backing layer 58 may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. 12, the tongue 9 and the groove 10, and preferably also the tongue 31 and the groove 32 are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels 1 preferably shall be displaced by means of two sequential perpendicular movements V1 and V2, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices 59–60, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices 61–62. During these processing, the floor panels 1 preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue 9–31 and groove 10–32 are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel 1.

This is illustrated in FIGS. 13, 14 and 15, wherein it is represented how a groove 10 is realized by means of two milling cycles by means of two milling cutters 63 and 64. FIGS. 16 and 17 represent how the tongue 9 is shaped by means of milling cutters 65 and 66.

The FIGS. 18–19 and 20–21 represent similar views showing how the groove 32 and the tongue 31 are shaped by means of milling cutters 67–68 and 69–70, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter 63 of FIG. 14 determines the final shape of the lower flank 71 of the groove 10, whereas the milling cutter 64 determines the final shape of the upper flank 72.

As mentioned in the introduction, preferably milling cutters 63 to 72 shall be used, having diameters G which are at least 5 times, and even better at least 20 times larger than the thickness F of the floor panels 1.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. 22 to 25, a particularly preferred form of embodiment of a floor panel 1 according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

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An important characteristic herein consists in that the coupling parts 4–5 are provided with locking elements 6 which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels 1 are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip 43, which, in engaged condition, is at least partially bent from a relaxed, unbent position and in this way creates a tension force which results in the engaged floor panels 1 being forced towards each other. The resultant bending V, as well as the tension force K, are indicated in the enlargement view of FIG. 23.

In order to obtain the tension force K pressing together the engaged floor panels 1, the bendable portion, in this case the lip 43, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface 73 which preferably can cooperate with a corresponding contact surface 74 on tongue 9. These contact surfaces 73–74 are similar to the aforementioned contact surfaces 39–38 and also similar to the inclined portions of the lower lip of FIGS. 2 to 4.

In the FIGS. 2 and 5, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. 23 can be realized.

Due to, on one hand, the contact along the angle A, and, on the other hand, the fact that a tension force K is created, a compression force component K1 is produced, as a result of which the floor panels 1 are drawn against each other in compression.

Preferably, the angle A of the mutual plane of tangency of contact surfaces 73–74 relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force K is realized, an angle A of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels 1 and, on the other hand, to ensure that the floor panels 1 can easily be engaged and respectively disassembled.

Although the pressing or compression force component K1 preferably is delivered by the aforementioned lip 43, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending V is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending V of the lip 43 only produces local bending of the underlayer.

Due to the fact that the lip 43 is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts 4–5, including the locking elements 33–34, and preferably the complete core 8, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

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HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. **22** to **25** consists in that the floor panels **1** can be selectively engaged by means of a turning movement, as represented in FIG. **24**, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. **25**, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending V_m results in the coupling parts, more particularly in the lip **43**, which bending V_m is less pronounced, if not nonexistent, as in the FIGS. **2** to **4**, in comparison to the bending V_m which results when the floor panels **1** are engaged by means of shifting them towards each other, as in FIG. **15**.

The advantage of this consists in that the floor panels **1** can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel **1** can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts **4-5** shown in FIGS. **22** to **25** can also be used for the coupling parts **28-29** of the short sides of the panels.

According to the invention, in the case that the four sides **2-3-26-27** are provided with coupling parts **4-5-28-29**, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels **1**, for example, such as represented in FIG. **1**, the locking at the small sides **26-27** preferably shall be more pronounced than at the longitudinal sides **2-3**. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces **73-74** with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element **33**, is bounded by at least two portions **75-76** (shown in FIG. **22**), respectively a portion **75** with a strong (steep) inclination which provides for the locking, and a portion **76** with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. **22** to **25**, these portions **75-76** are formed by straight planes, but, as already described with reference to FIG. **9**, use can also be made of curved portions **50-51**. In FIG. **5**, these are the contact surface **38** and the inclined portion **40**.

In the preferred form of the invention, the floor panels **1** comprise coupling parts **4-5** and/or **28-29** exhibiting one of the following or the combination of two or more of the following features:

a curvature **77** (shown in FIG. **22**) at the lower side of the tongue **9** and/or a curvature **78** at the lower lip **43** which

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form a guidance when turning two floor panels **1** into each other, with the advantage that the floor panels **1** can be engaged into each other easily during installation;

roundings **79-80** at the edges of the locking elements **33-34**, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels **1** and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;

dust chambers **81**, or spaces **21** as in FIG. **4**, between all sides, directed laterally towards each other, of the engaged floor panels **1**, with the advantage that inclusions which get between the floor panels **1** during the engagement do not exert an adverse influence upon good engagement;

a shaping of the tongue **9** which is such, for example, by the presence of a chamfer **82**, that the upper side of the tongue **9** becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip **42** when the floor panels **1** are pushed towards each other in substantially the same plane, as indicated in FIG. **25**, with the advantage that the front extremity or end of the tongue **9** does not press against the front side of the upper lip **42** or the front edge of the bottom lip **43** when the floor panels are pushed towards each other in the same plane;

a ramp surface **83**, hereinbefore also called inclined portion **41**, formed at the distally outer end of the lower lip **43**, with the advantage that the locking elements **33-34** shift smoothly over each other and that the lower lip **43** is bent uniformly;

in the engagement direction only one important contact point which is formed by a section **84** at the location of the upper side edges of the floor panels **1**, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels **1** and that the development of openings between the floor panels **1** is counteracted;

contact surfaces **85-86**, more particularly abutment surfaces, formed by the upper side of the tongue **9** and the upper side of the groove **10** which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels **1**, as well as contact surfaces cooperating with each other, formed by curvatures **77-78**, with the advantage that no mutual displacement in height between two engaged floor panels **1** is possible, even if the insertion depth of the tongue **9** into the groove **10** should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. **22** to **25**, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. **2** to **11**, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. **5** to **7** and **22** to **25**, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element **6**, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip **23-43** which extends beyond the distal edge of the upper lip **22-42**, more particularly, the lowermost point **87** of the locking part **33** is situated under the top layer of the floor panel **1**. For clarity's sake, this top layer is indicated in the FIGS. **22-25** only as a single layer.

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It should be noted that the combination of features, the lower lip **23-43** extending further than the upper lip **22-42**; the locking elements **6** being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip **23-43** which extends distally beyond the upper lip **22-42**, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels **1** can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip **23-43** adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface **39** or **73**, preferably extends in such a manner that the distance between the upper edge **16** of the panel to the contact surface **39**, **73** diminishes between the proximal and distal ends of the sloping contact surface **39**, **73**, in other words, such that, as represented in FIG. **22**, the distance **X2** is smaller than the distance **X1**. This is also the case in FIG. **7**.

Still preferably, this portion only starts at a clear distance **E1** from the outer edge of upper lip **42**.

It is obvious that the coupling parts **22** to **25** can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels **1** are treated at their sides **2-3** and/or **26-27** with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. **22**, such impregnation **88** is represented schematically. This treatment can be performed over the complete surface of the sides **2-3** and/or **26-27** or only over specific portions hereof, for example exclusively on the surfaces of the tongue **9** and the groove **10**.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts **4-5** and/or **28-29** better keep their shape and strength, even if the floor panels **1** are engaged and disassembled repeatedly. In particular, if the core **8** is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels **1** can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

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What is claimed is:

1. A floor covering panel comprising a substantially planar under side and at least two opposed side edges;

said side edges including cooperative coupling parts configured to cooperate with identical cooperative complementary coupling parts of another one of said panel;

said coupling parts comprising substantially a tongue and a groove extending distally transversely along panel side edges including mechanical locking elements;

said tongue, groove and locking elements formed in one piece with the panel;

said tongue groove and locking elements cooperating to prevent drifting apart of the floor panel when coupled by said coupling parts to another one of said floor panel in directions perpendicular to the adjacent side edges of the coupled panels, and parallel to the undersides of the coupled panels;

a coupling part of said panel, when engaged with a cooperating coupling part of another one of said panel, urging the coupled panels towards each other;

at least one of said coupling parts including an elastically bendable portion having a relaxed unbent position, and which, when in a coupled condition, is at least slightly bent out of its normal relaxed unbent position to effect said urging of the coupled panels together.

2. The floor covering panel according to claim **1**, wherein the elastically bendable portion of said one of said coupling parts comprises a lower lip defining at least in part a lower side of the groove of said coupling parts, said lower lip cooperating with a mating portion of a tongue of a cooperating coupling part when the cooperating parts are coupled.

3. The floor covering panel according to claim **2**, wherein said lip when elastically bent extends in a downward direction relative to the panel underside when the panel is coupled by said coupling parts to another one of said panel.

4. The floor covering panel according to claim **3**, wherein the panel comprises a core comprising a material selected from the group consisting of HDF and MDF;

a lower lip of a coupling parts is substantially formed of said core; one of said locking elements comprises a recess in said lower lip, said recess having a lowermost bottom area;

said groove of said coupling parts having a deepest point within the panel; and

wherein said elastically bendable portion of the lower lip comprises a portion of said lower lip located between the deepest point of said groove and the lowermost bottom area of said recess.

5. The floor covering panel according to claim **4**, wherein a portion of the lower lip that is elastically bendable includes a side wall area of said recess that slopes downwardly in a direction extending from a distally outer area of said lip towards a proximally inner area of said lip.

6. The floor covering according to any one of claims **1** to **5**, wherein upon coupling the coupled panels are urged together without play.

* * * * *

EXHIBIT D

(12) **United States Patent**
Moriau et al.

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(54) **FLOOR PANELS WITH EDGE CONNECTORS**

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Related U.S. Application Data

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(58) **Field of Search** **52/403.1, 480, 52/506.1, 506.05, 582.1, 592.2, 551**

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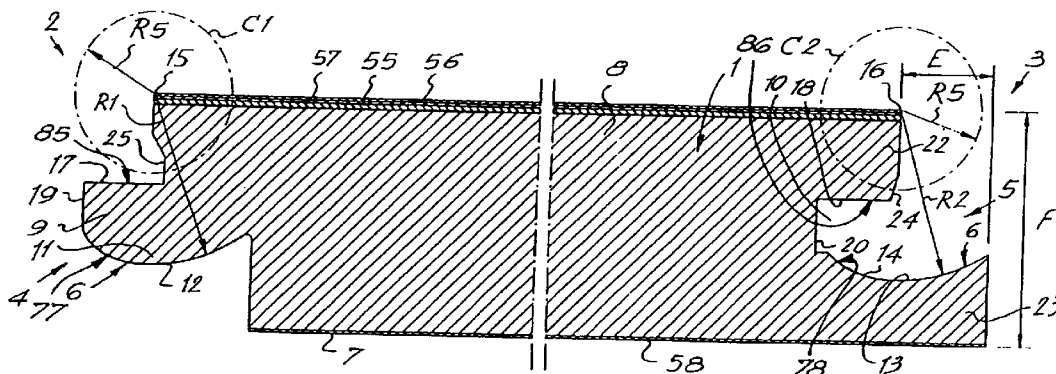
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(57) **ABSTRACT**

Floor covering, including hard floor panels which, at least at the edges of two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges and parallel to the underside of the coupled floor panels, and provide a snap-action coupling.

29 Claims, 10 Drawing Sheets



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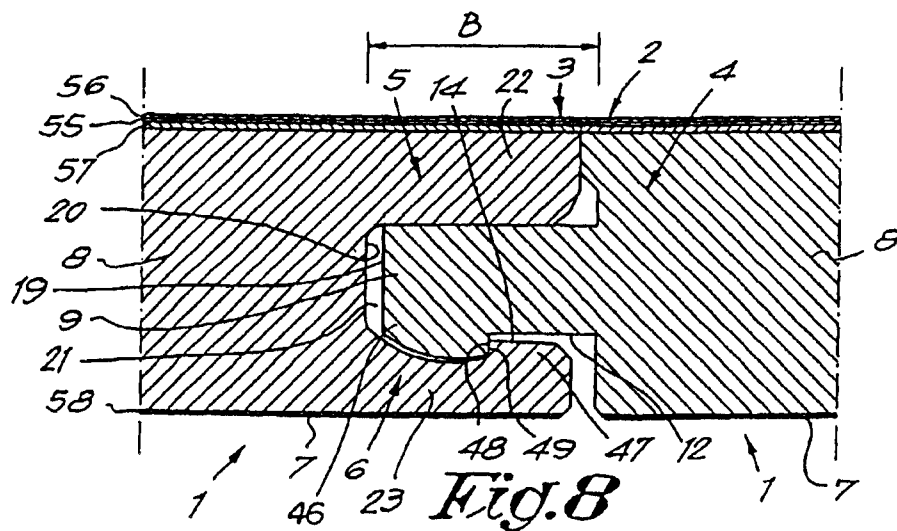
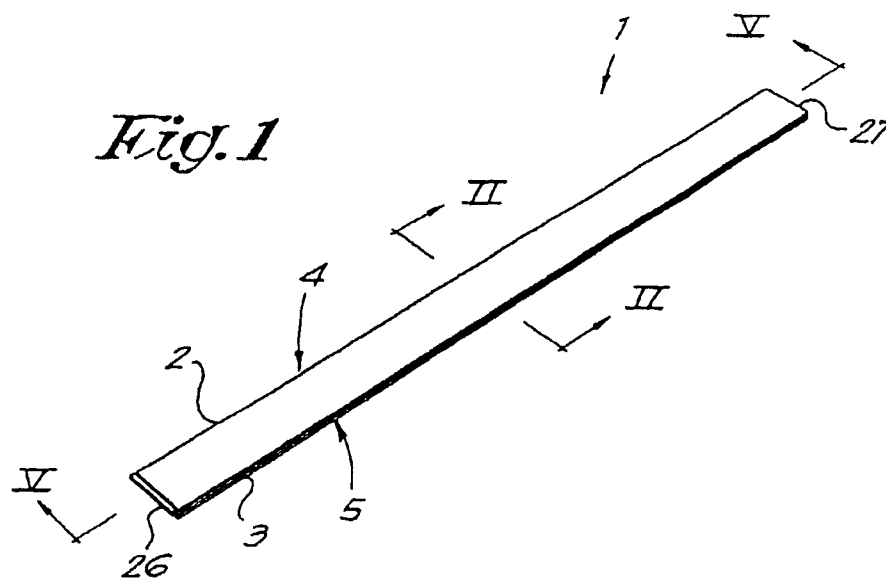
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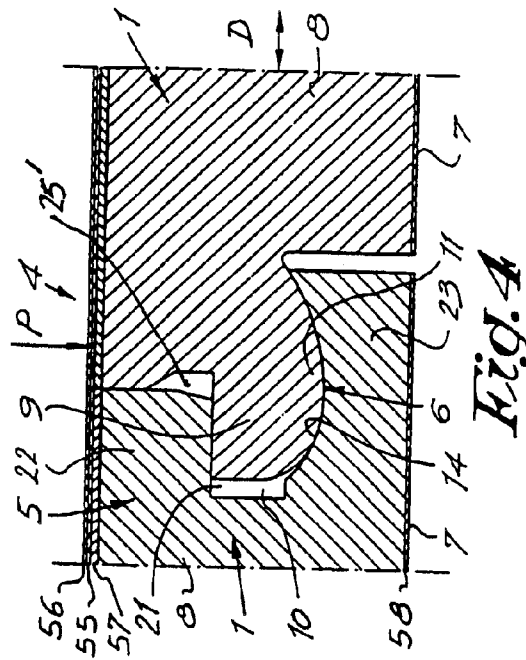
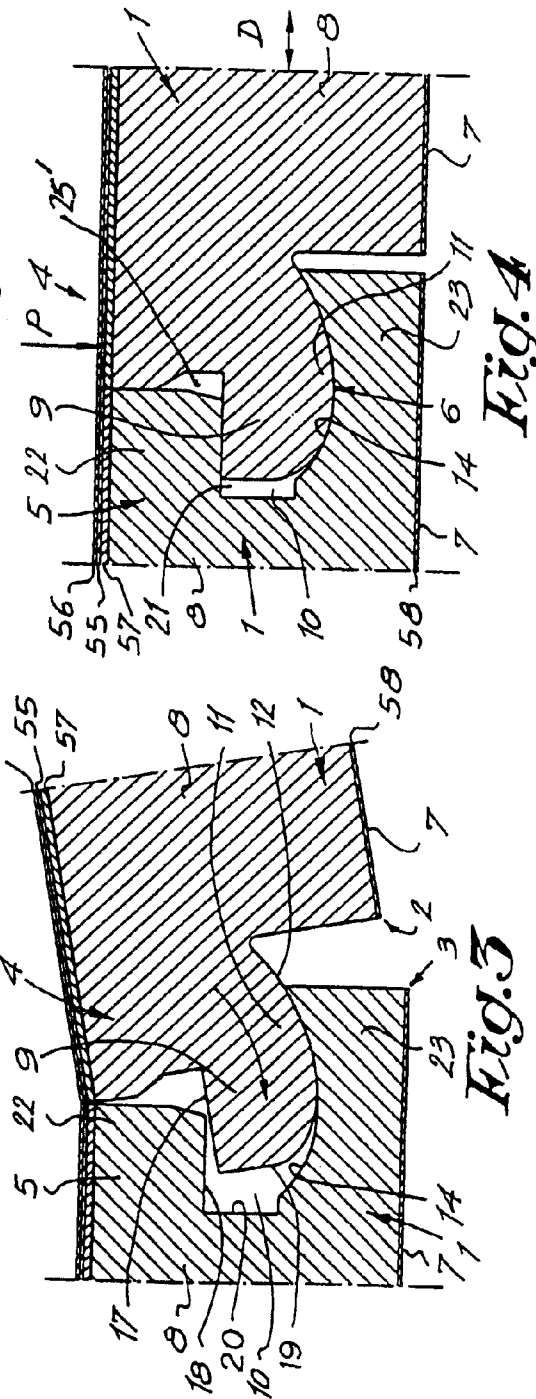
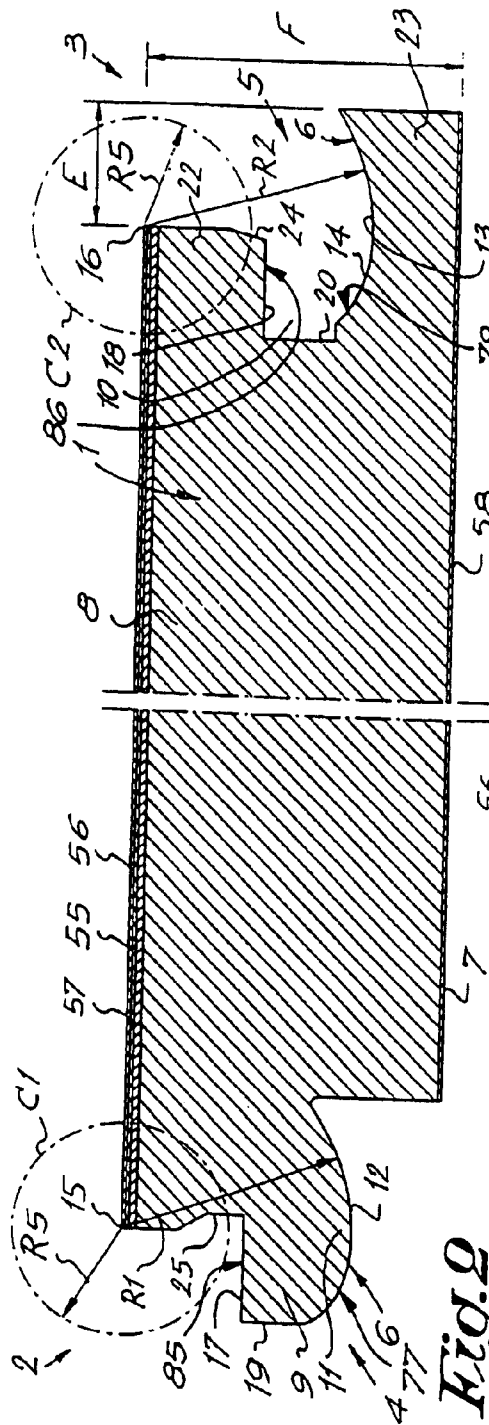
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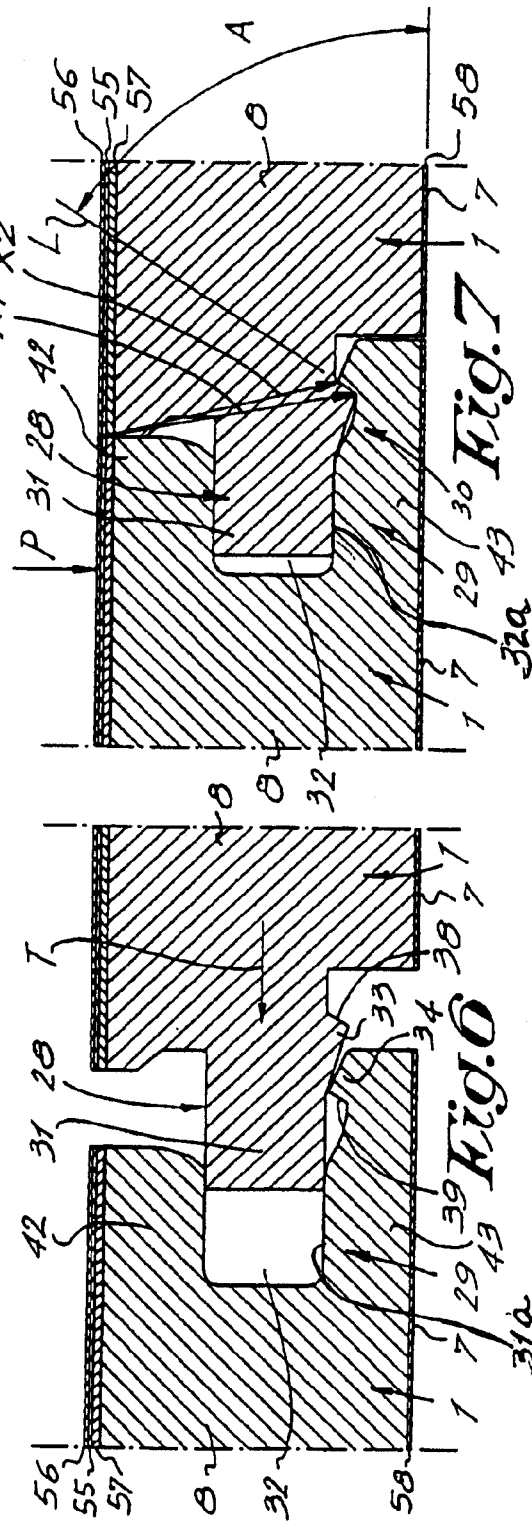
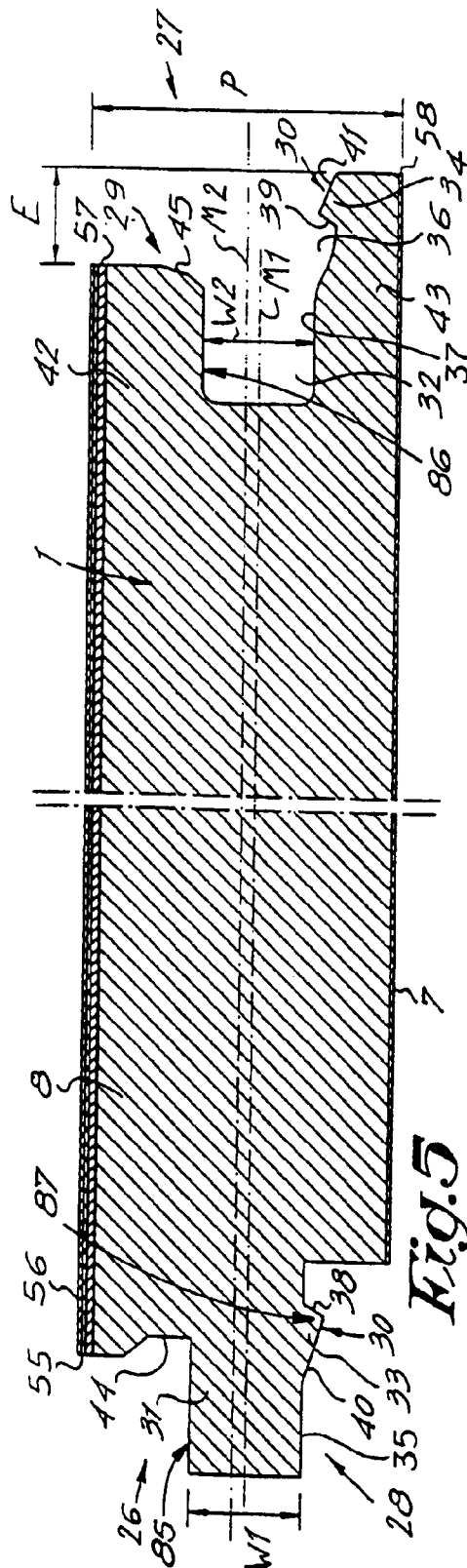
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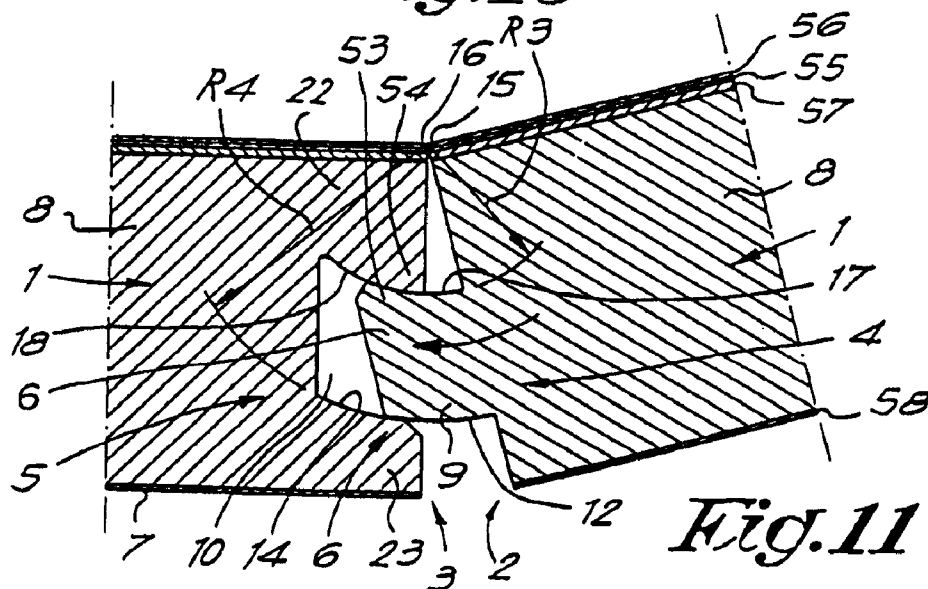
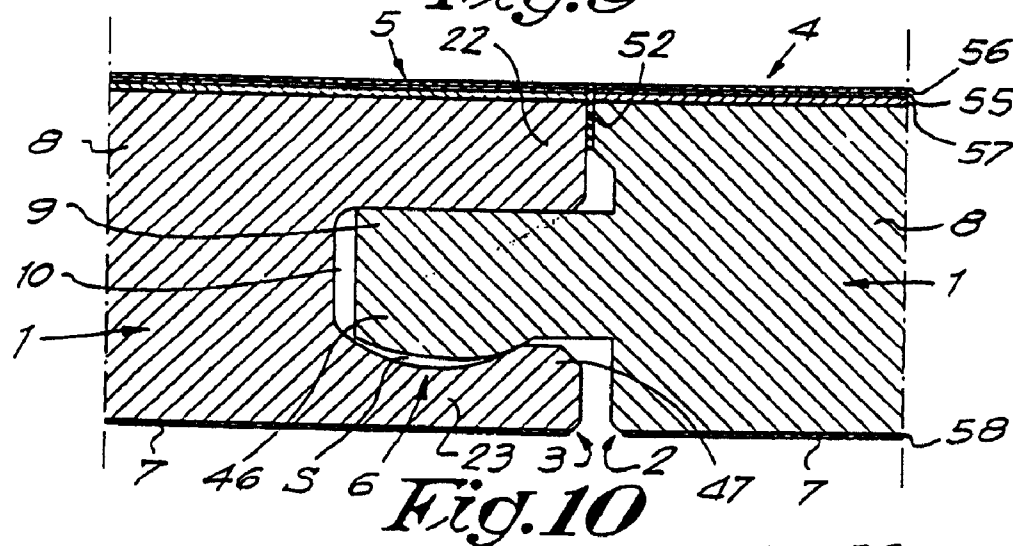
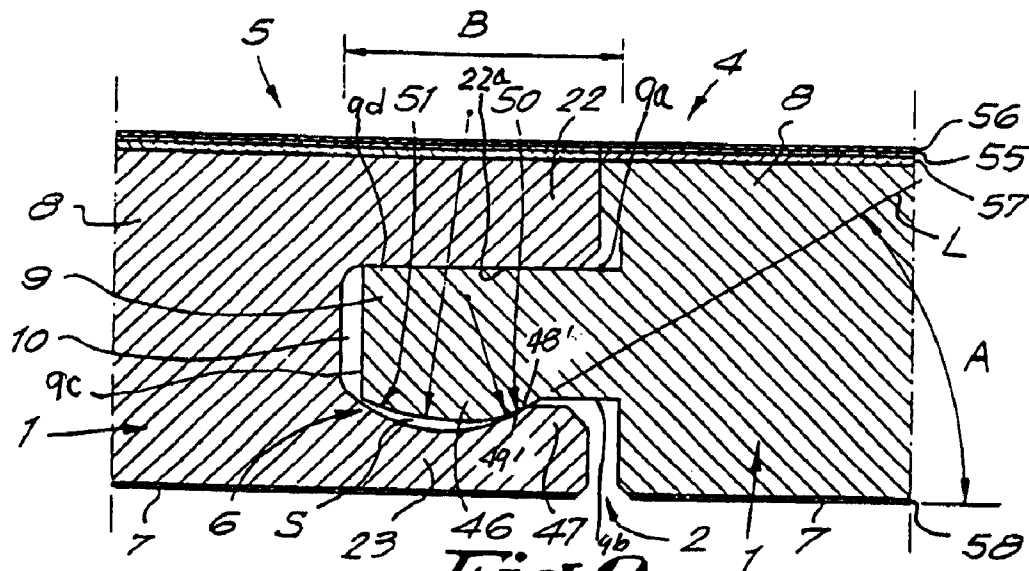


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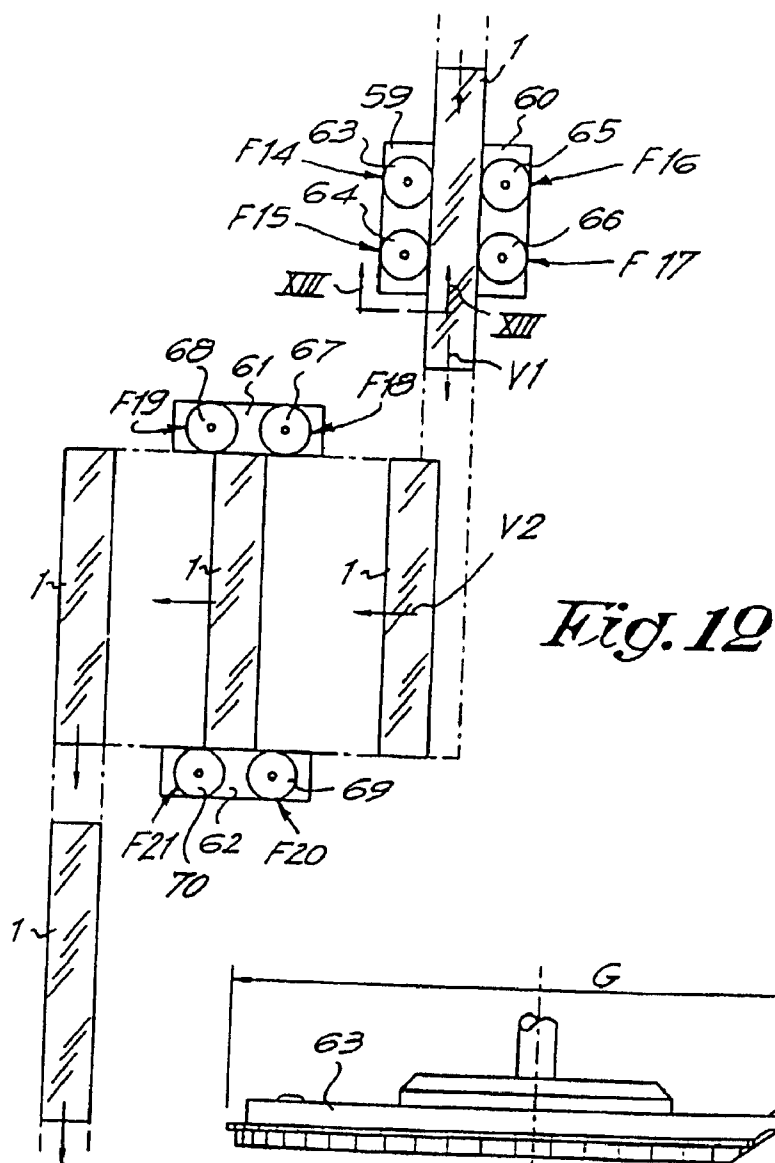


Fig. 12

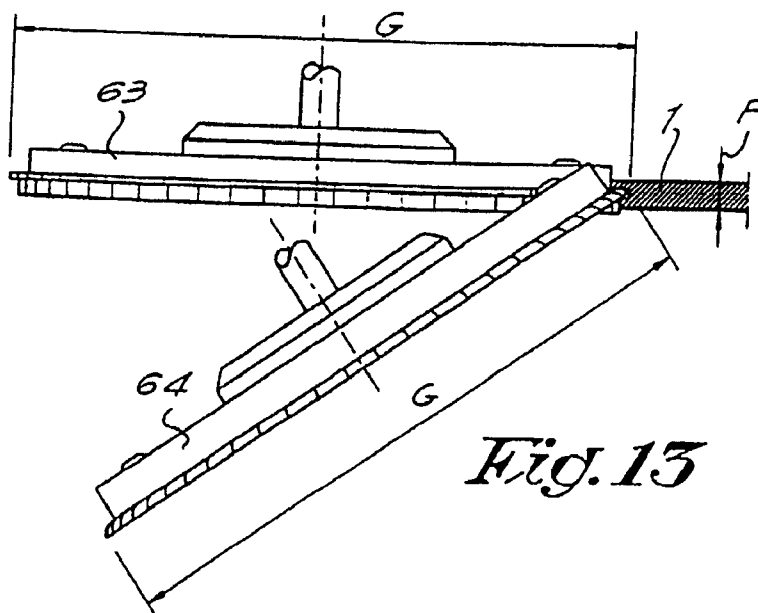


Fig. 13

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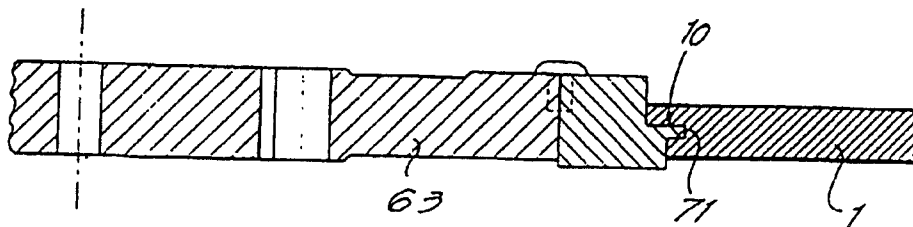


Fig. 14

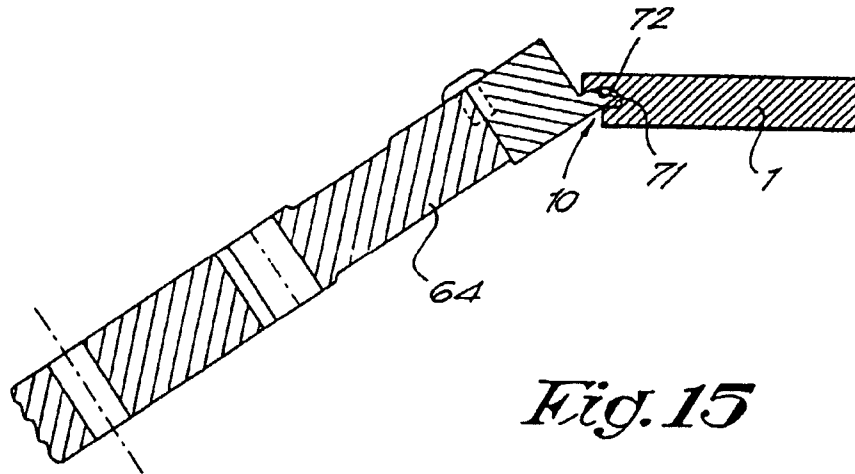


Fig. 15

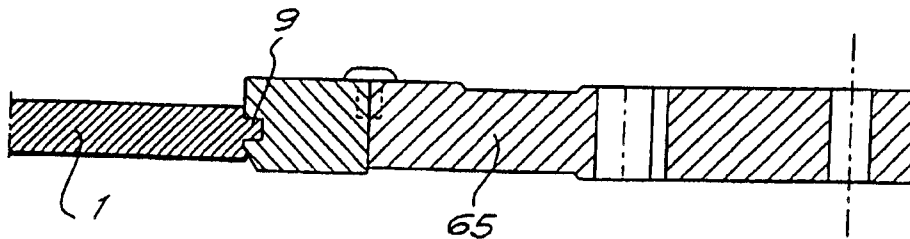


Fig. 16

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Fig. 17

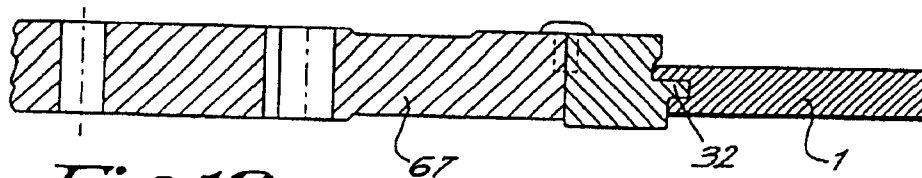
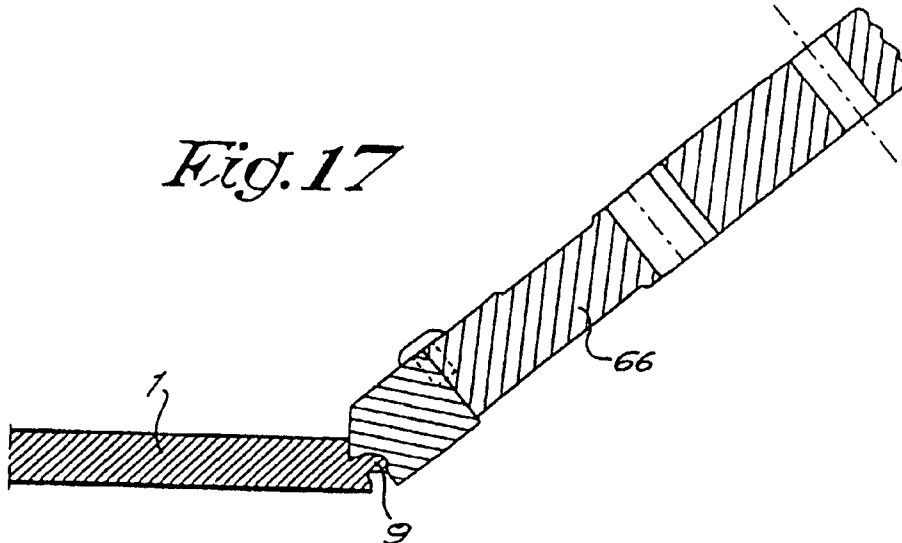


Fig. 18

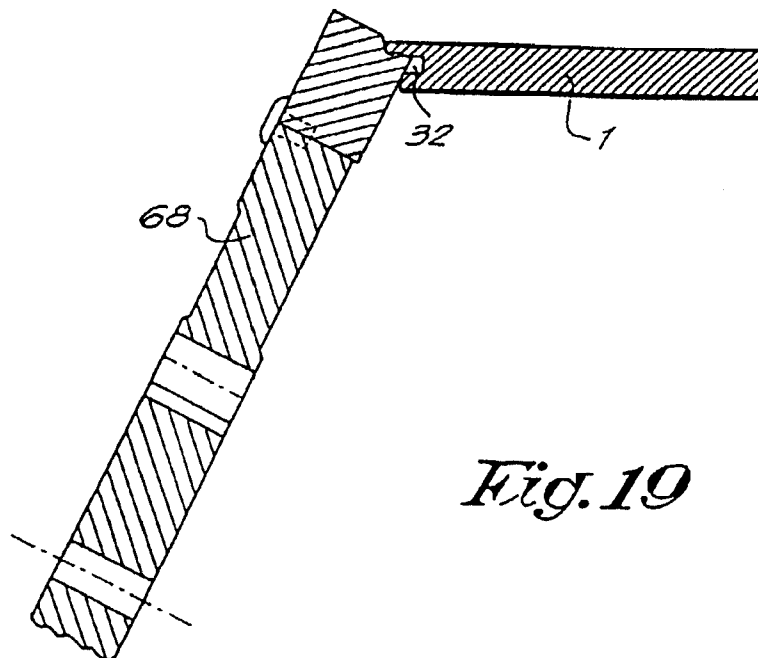


Fig. 19

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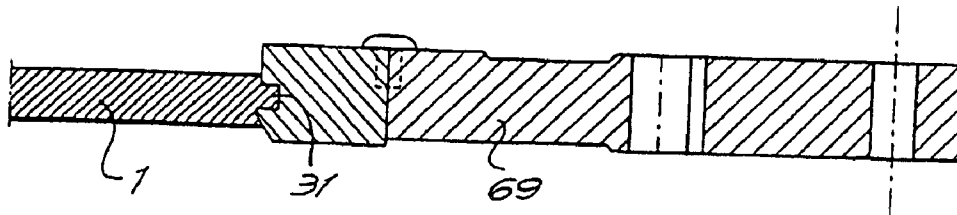
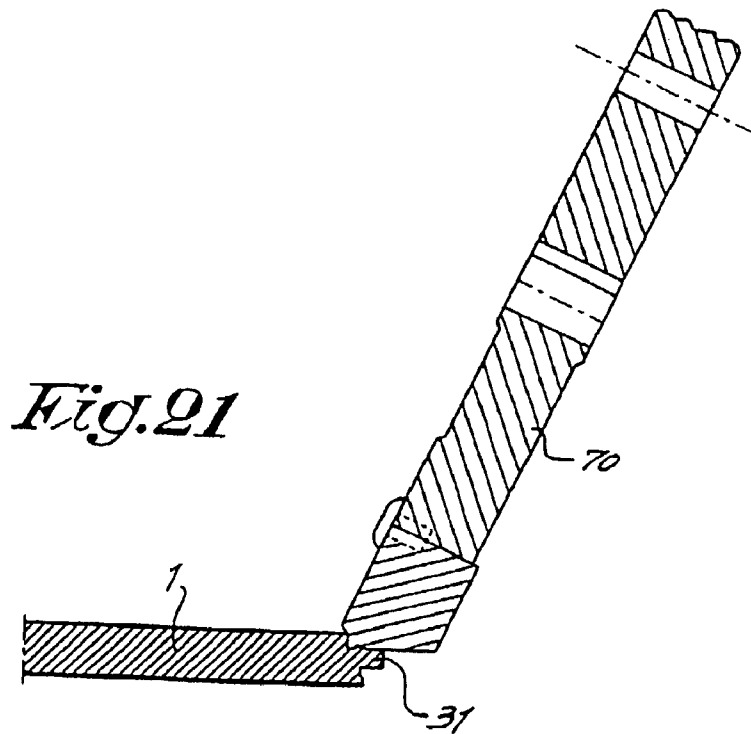
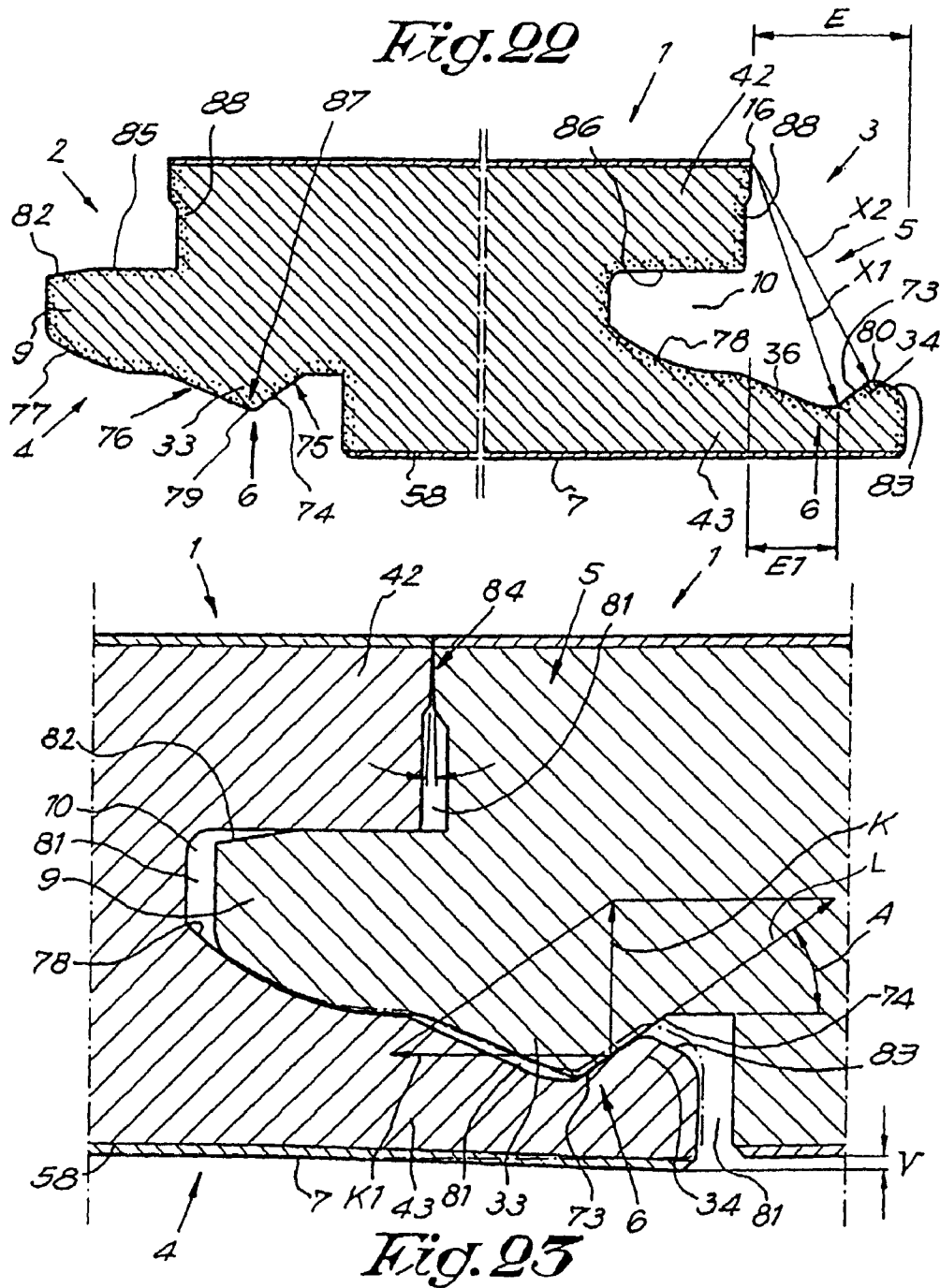
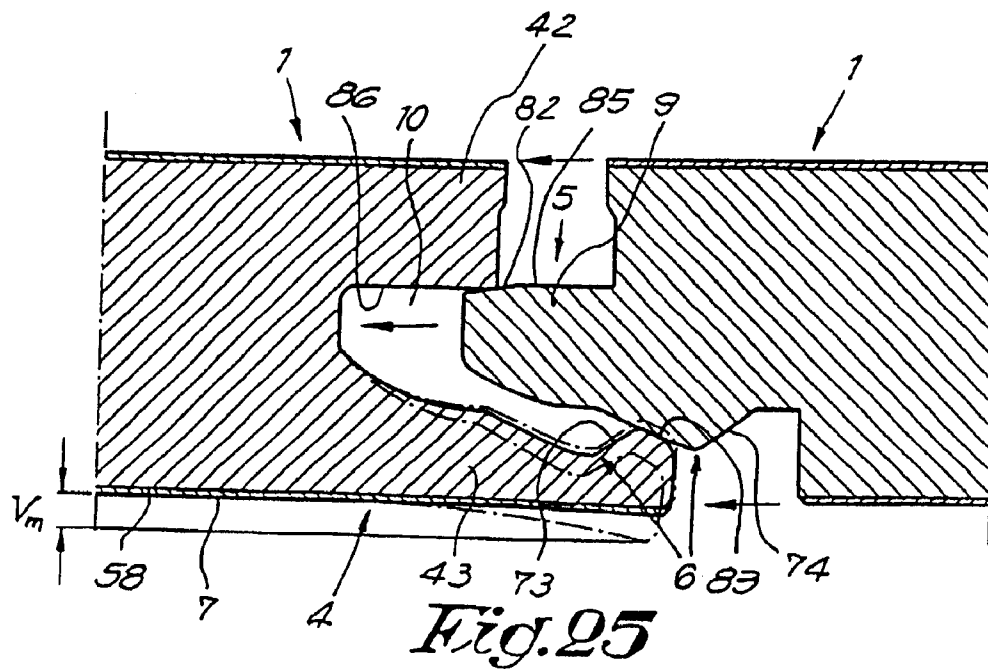
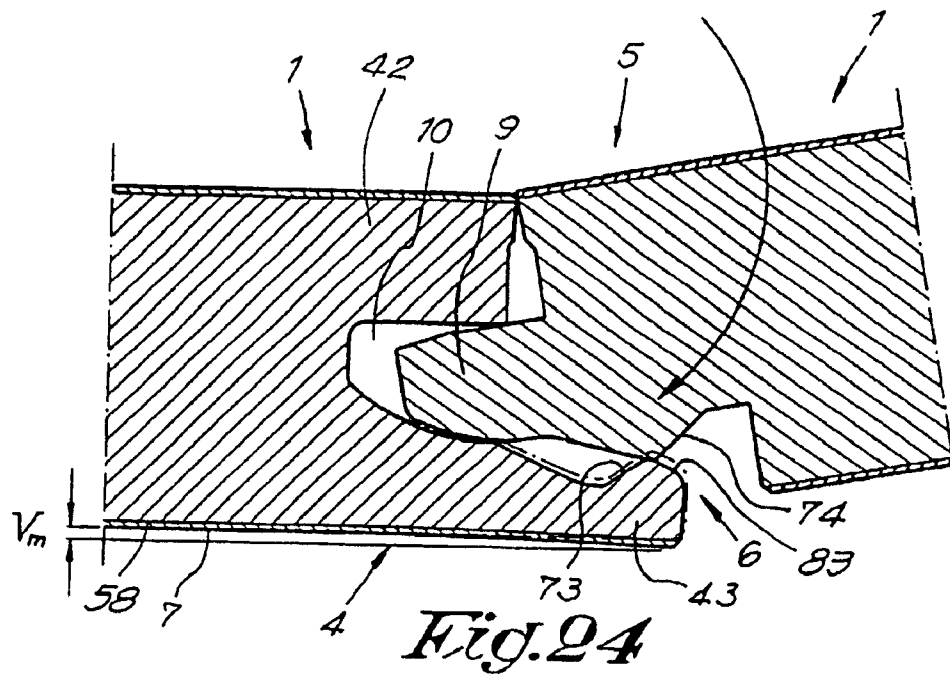


Fig. 20







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FLOOR PANELS WITH EDGE CONNECTORS**RELATED APPLICATION DATA**

This application is a continuation of pending application Ser. No. 09/471,014, filed Dec. 23, 1999, now U.S. Pat. No. 6,490,836; which is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997, now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION**1. Field of the Invention**

This invention relates to floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE

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3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into

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a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles (fibers) and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

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In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. 1 represents a floor panel of a floor covering according to the invention;

FIG. 2, on a larger scale, represents a cross-section according to line II—II in FIG. 1;

FIGS. 3 and 4 represent how two floor panels with coupling parts according to FIG. 2 match into each other;

FIG. 5, on a larger scale, represents a cross-section according to line V—V in FIG. 1;

FIGS. 6 and 7 represent how two floor panels with coupling parts according to FIG. 5 match into each other;

FIGS. 8 to 11 represent a number of variants of coupling parts of floor panels according to the invention;

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FIG. 12 schematically represents how the floor parts can be provided with coupling parts;

FIG. 13 represents a cross-section according to line XIII—XIII in FIG. 12;

FIGS. 14 to 21, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. 12 with arrows F14 to F21;

FIG. 22 represents a floor panel according to the invention;

FIG. 23, on a larger scale, represents the coupling of two floor panels of FIG. 22;

FIGS. 24 and 25 represent two manners of coupling floor panels according to FIG. 22 to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels 1, for example, such as a laminated panel as shown in FIG. 1.

These floor panels 1 can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. 1, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is, at least at the edges of two opposite sides 2-3, provided with coupling parts 4-5 which permit two adjacent identical floor panels 1 to be coupled to each other.

According to the invention, the coupling parts 4-5, as represented in the FIGS. 2 to 4, are provided with integrated mechanical locking parts or locking elements 6 which prevent the drifting or sliding apart of two coupled floor panels 1 in a direction D perpendicular to the respective sides 2-3 and parallel to the underside 7 of the coupled floor panels 1; the coupling parts 4-5 and the locking elements 6 are formed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two subsequent floor panels 1 can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel 1 can be laterally inserted into the previous; and the coupling parts 4-5 preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels 1 with an elongated shape, as represented in FIG. 1, the respective coupling parts 4-5 are located at the longitudinal sides 2-3.

The coupling parts 4-5 can be realized in various forms, although the basic forms thereof will always be formed by a tongue 9 and a groove 10.

In the form of embodiment of FIGS. 2 to 4, the related floor panel 1 is provided with coupling parts 4-5 and locking means or locking elements 6 which allow two floor panels 1 to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements 6 consist of a first locking element 11, formed by a protrusion with a bent round shape at the lower side 12 of the tongue 9, and a second locking element 13 (shown in FIG. 2), formed by a recess with a bent hollow or downwardly concave shape in the lower wall 14 of the groove 10.

The locking elements 11-13 ensure that two floor panels 1 which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

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In order to enable two floor panels 1 to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side 12 of locking means or locking elements 6 has a curvature with a radius R1, the center of which coincides with the respective upper edge 15 of the floor panel 1, whereas the lower wall 14 of the locking part 5 has a curvature with a radius R2 which is equal to the radius R1, but its center coincides with the respective upper edge 16. Radii R1 and R2 may also be applied which are larger or smaller than the distance to the upper edge 15, 16 respectively, and/or which differ from each other in size.

The upper side 17 of the tongue 9 and the upper wall or side 18 of the groove 10 are preferably flat and preferably are located in the horizontal plane.

The inner side 20 of the groove 10 and the front side 19 of the tongue 9 of the two interlocked floor panels 1 preferably do not fit closely against each other, such that an intermediate space or clearance 21 is created between them into which possible dust remainders or such can be pushed away by means of the tongue 9.

The tongue 9 and the groove 10 preferably have shapes which are complementary to each other, such that the tongue 9 in the engaged condition of two identical floor panels 1 precisely sits against the upper wall 18 and the lower wall 14 of the groove 10, whereby a pressure P, exerted against the upper lip 22, is received or reacted not only by this lip 22, but by the complete structure, because this pressure can be transmitted through the tongue 9 and the lower lip 23 to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer 24 on lip 22 and a recess or clearance 25 can be provided, as represented in FIGS. 2 to 4, as a result of which the subsequent floor panels 1 can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult. The recess 25 defines a chamber 25' (FIG. 4) when the floor panels are coupled, the chamber 25 created between the tongue 9 and the upper edges 15, 16. The upper lip 22 of edge 3 engages the opposing panel edge 2 below upper edge 15 along a contact surface that is perpendicular to the plane of the coupled panels, as shown.

As represented in the FIGS. 5 to 7, the floor panels 1 according to the invention can also, along the sides 26-27 which are at a right angle to the sides 2-3, be provided with coupling parts 28-29 which have locking elements 30, too. The coupling parts 28-29 are preferably also realized in the shape of a tongue 31 and a groove 32. Hereby, the locking elements 30 do not have to be of the same nature as the locking elements 6.

Preferably, at the sides 26-27 locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. 6 and 7. To this aim, the locking elements 30 consist of a snap-together connection with locking elements 33 and 34 which grip behind each other.

As represented in FIGS. 5 to 7, the locking element 33 preferably consists of a protrusion of the lower side 35 of the tongue 31 which can be located in a recess 36 in a lower lip 43 extending distally from the lower wall 37 of the groove 32. The locking element 34 is formed by the upward directed part or protrusion which defines the distally outer end of recess 36.

In this case, the locking elements 33-34 have contact surfaces 38-39 which are parallel to each other and prefer-

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ably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces **38–39**, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside **7**, which angle is smaller than 90°.

The locking elements **33–34** preferably are provided with inclined portions **40** and **41** which, when two floor panels **1** are engaged, cooperate with each other in such a manner that the locking elements **33–34** can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. **6** and **7**).

The thickness **W1** of the tongue **31** preferably is equal to the width **W2** of the groove **32**, such that compression pressure P applied to the upper lip **42** is reacted by the tongue **31** which, in its turn, then is reacted by the lower lip **43**.

Analogous to the chamfer **24** and recess **25**, a recess or clearance **44** and a chamfer **45** are provided also at the edges **28–29**.

It is noted that such a snap-together coupling can also be applied at the edges **2–3**. Hereby, this can be a snap-together coupling analogous to these of FIGS. **5** to **7**, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. **8** and **9**. Contrary to the locking elements **33–34** which consist of rather local protrusions, in the forms of embodiment of FIGS. **8** and **9** use is made of locking elements **46–47** which, in comparison to the total width B of the coupling, extend over a rather large distance.

In this case, the locking elements **46–47** are also provided at the lower side **12** of the tongue **9** and the lower wall **14** of the groove **10**.

According to FIG. **8**, the locking elements **46–47** have contact surfaces **48–49** which are at a vertical angle with the plane of the floor panel **1**. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. **9**, the locking elements **46–47** possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The contact surfaces **48'**, **49'**, directed towards each other, of the locking elements **46–47** in this embodiment consist of curved surfaces. The common plane of tangency L forms an angle A which is smaller than 90°, and more preferably is smaller than 70°.

In this manner, the locking element **46** preferably has two portions with a different curvature, on one hand, a portion **50** with a strong curvature and, on the other hand, a portion **51** with a weak curvature. The portion **50** with the strong curvature provides for the formation of a firm coupling. The portion **51** with the weak curvature facilitates the coupling parts **4–5** to be brought into each other easily. The intermediate space S forms a chamber which offers space for dust and the like which, when engaging two floor panels **1**, inevitably infiltrates there. The chamber at intermediate space S, the chamber **25'** defined by recess **44**, and clearance **21** are or may be essentially independent clearances or chambers when the tongue and groove elements are coupled, as illustrated. It will be noted that the tongue **9** in FIGS. **9** and **10** has a cross-sectional periphery that defines the outer shape of the tongue in transverse cross-section. As illustrated, the tongue **9** includes an upper surface **9a**, a lower surface **9b** and a distalmost surface **9c**, the outer form

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or profile of the tongue along and connecting these surfaces constituting a tongue periphery that includes an upper tongue contact surface **9d** that engages an upper groove or lip contact surface **22a** when panels are coupled as seen in FIG. **9** and a lower contact surface **48'** engaging the lower groove or lip contact surface **49'** intersecting the common plane of tangency L in this example.

As seen in FIGS. **5**, **6** and **7**, an intermediate lower tongue contact surface **31a** engages intermediate lower groove, or lip contact surface **32a** when the tongue **31** and groove **32** are coupled together. The intermediate contact surfaces are located along the periphery of tongue **31** and the surface of groove **32** between lower contact surfaces **38**, **39** and upper contact surfaces **85**, **86** between the tongue and groove elements.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. **7** to **9**, preferably the tongue **9–31** has a shape that thickens from below, which then can cooperate with a widened portion in the groove **10**.

In FIG. **10**, a variant is represented whereby at least at the level of the upper edges **15–16**, a sealing material **52** is provided, as a result of which a watertight sealing can be assured. This sealing material **52** may consist of a strip or covering which is provided previously at the floor panel **1**, either at one or both upperside edges **15–16**.

In FIG. **11**, a further variant is represented, whereby the locking element **6** is formed by an upward directed portion **53** at the tongue **9**, which as a result of a turning movement of the panel, is brought behind a downward-directed portion **54** on the upper wall **18**. More particularly, this is obtained by forming the upper side **17** and the upper wall **18** with a curvature R3, the center of which is situated at the upperside edges **15–16**, and forming the lower side **12** and the lower wall **14** with a radius R4, the center of which is also situated at the upperside edges **15** and **16**, respectively. These radii R3–R4 can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius R1, R3 respectively, and, on the other hand, the radius R2, R4 respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle C1, C2 (see FIG. **2**) respectively, which extends with a radius R5 of 3 mm centered at upperside edge **15,16** respectively.

Finally is noted that, according to the invention, the lower lip **23–43**, as represented in FIGS. **2** to **7**, can be formed distally longer than the upper lip **22–42**. This has an advantage that the coupling parts **4–5–28–29** can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels **1**, because each subsequent floor panel **1** during installation can be placed upon the protruding lower lip **23–43**, as a result of which the tongue **9–31** and the groove **10–32** automatically are positioned in front of each other.

The embodiments wherein the lower lip **23** of the groove element is equal to or distally shorter than the upper lip **22**, in their turn, offer the advantage that no protruding lip **23** remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference E between the distally outer edge of the upper lip **22–42** and the distally outer edge of the lower lip **23–43**, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove **10**, should preferably be kept smaller than

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one time the total thickness F of the floor panel 1. For stability's sake, normally this total thickness F shall never be less than 5 mm.

The small dimension of the difference E offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line M1 through the tongue 9 and the groove 10 is situated lower than the center line M2 of the floor panel 1, such, that the upper lip 22-42 is thicker than the lower lip 23-43. In first instance, this is essential in this kind of connection, because then it is the lower lip 23-43 which bends, whereby the upper side of the floor panel 1 is kept free of possible deformations.

As explained in the introduction, for the core 8 a material is chosen from the following series:

a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;

a product based on synthetic material;
chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. 2 to 11, such laminated flooring preferably consists of a core 8 made of MDF medium density fiberboard board, HDF high density fiberboard board or similar, whereby at least at the upper side of this core 8 one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer 55 and a protective top layer 56. The decorative layer 55 is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer 56 preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer 57 upon which the decorative layer 55 is provided.

Preferably, also a backing layer 58 shall be applied at the underside 7, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel 1. This backing layer 58 may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. 12, the tongue 9 and the groove 10, and preferably also the tongue 31 and the groove 32 are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels 1 preferably shall be displaced by means of two sequential perpendicular movements V1 and V2, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices 59-60, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices 61-62. During these processing, the floor panels 1 preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue 9-31 and groove 10-32 are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel 1.

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This is illustrated in FIGS. 13, 14 and 15, wherein it is represented how a groove 10 is realized by means of two milling cycles by means of two milling cutters 63 and 64. FIGS. 16 and 17 represent how the cross section periphery of tongue 9 is shaped by means of milling cutters 65 and 66.

The FIGS. 18-19 and 20-21 represent similar views showing how the groove 32 and the cross-section periphery of tongue 31 are shaped by means of milling cutters 67-68 and 69-70, positioned at angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter 63 of FIG. 14 determines the final shape of the lower flank 71 of the groove 10, whereas the milling cutter 64 determines the final shape of the upper flank 72.

As mentioned in the introduction, preferably milling cutters 63 to 72 shall be used, having diameters G which are at least 5 times, and even better at least 20 times larger than the thickness F of the floor panels 1.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. 22 to 25, a particularly preferred form of embodiment of a floor panel 1 according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

An important characteristic herein consists in that the coupling parts 4-5 are provided with locking elements 6 which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels 1 are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip 43, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels 1 being forced towards each other. The resultant bending V, as well as the tension force K, are indicated in the enlargement view of FIG. 23.

In order to obtain the tension force K pressing together the engaged floor panels 1, the bendable portion, in this case the lip 43, preferably is provided, as represented, with an inwardly and downwardly inclined lower lip contact surface 73 which preferably can cooperate with a corresponding lower tongue contact surface 74 on tongue 9. These contact surfaces 73-74 are similar to the aforementioned contact surfaces 39-38 and also similar to the inclined portions of the lower lip of FIGS. 2 to 4.

In the FIGS. 2 and 5, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. 23 can be realized.

Due to, on one hand, the contact along the angle A, and, on the other hand, the fact that a tension force K is created, a compression force component K1 is produced, as a result of which the floor panels 1 are drawn against each other in compression.

Preferably, the angle A of the mutual plane of tangency of contact surfaces 73-74 relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force K is realized, an angle A of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels 1 and, on the other hand, to ensure that the floor panels 1 can easily be engaged and respectively disassembled.

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Although the pressing or compression force component **K1** preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending **V** is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending **V** of the lip **43** only produces local bending of the underlayer.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4-5**, including the locking elements **33-34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. **22** to **25** consists in that the floor panels **1** can be selectively engaged by means of a turning movement, as represented in FIG. **24**, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. **25**, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending **V_m** results in the coupling parts, more particularly in the lip **43**, which bending **V_m** is less pronounced, if not nonexistent, as in the FIGS. **2** to **4**, in comparison to the bending **V_m** which results when the floor panels **1** are engaged by means of shifting them towards each other, as in FIG. **15**.

The advantage of this consists in that the floor panels **1** can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel **1** can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts **4-5** shown in FIGS. **22** to **25** can also be used for the coupling parts **28-29** of the short sides of the panels.

According to the invention, in the case that the four sides **2-3-26-27** are provided with coupling parts **4-5-28-29**, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction

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is effected. In the case of elongated floor panels **1**, for example, such as represented in FIG. **1**, the locking at the small sides **26-27** preferably shall be more pronounced than at the longitudinal sides **2-3**. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces **73-74** with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element **33**, is bounded by at least two portions **75-76** (shown in FIG. **22**), respectively a portion **75** with a strong (steep) inclination which provides for the locking, and a portion **76** with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. **22** to **25**, these portions **75-76** are formed by straight planes to define local sharp protrusions, but as already described with reference to FIG. **9**, use can also be made of curved portions **50-51**. In FIG. **5**, these are the contact surface **38** and the inclined portion **40**.

In the preferred form of the invention, the floor panels **1** comprise coupling parts **4-5** and/or **28-29** exhibiting one of the following or the combination of two or more of the following features:

- a curvature **77** (shown in FIG. **22**) at the lower side of the tongue **9** and/or a curvature **78** at the lower lip **43** which form a guidance when turning two floor panels **1** into each other, with the advantage that the floor panels **1** can be engaged into each other easily during installation;

- roundings **79-80** at the edges of the locking elements **33-34**, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels **1** and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;

- dust chambers or clearances **81**, or spaces **21** as in FIG. **9**, or chamber **25'** in FIG. **4**, or spaces **S** in FIG. **9**, between all sides, directed laterally towards each other, of the engaged floor panels **1**, with the advantage that inclusions which get between the floor panels **1** during the engagement do not exert an adverse influence upon good engagement;

- a shaping of the tongue **9** which is such, for example, by the presence of a chamfer **82**, that the upper side of the tongue **9** becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip **42** when the floor panels **1** are pushed towards each other in substantially the same plane, as indicated in FIG. **25**, with the advantage that the front extremity or end of the tongue **9** does not press against the front side of the upper lip **42** or the front edge of the bottom lip **43** when the floor panels are pushed towards each other in the same plane;

- a ramp surface **83**, hereinbefore also called inclined portion **41**, formed at the distally outer end of the lower lip **43**, with the advantage that the locking elements **33-34** shift smoothly over each other and that the lower lip **43** is bent uniformly;

in the engagement direction only one important contact point which is formed by a section **84** at the location of the upperside edges of the floor panels **1**, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor

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panels 1 and that the development of openings between the floor panels 1 is counteracted;

contact surfaces 85-86, more particularly abutment surfaces, formed by the upper side of the tongue 9 and the upper side of the groove 10 which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels 1, as well as contact surfaces cooperating with each other, formed by curvatures 77-78, with the advantage that no mutual displacement in height between two engaged floor panels 1 is possible, even if the insertion depth of the tongue 9 into the groove 10 should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. 22 to 25, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. 2 to 11, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. 5 to 7 and 22 to 25, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element 6, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip 23-43 which extend beyond the distal edge of the upper lip 22-42, more particularly, the lowermost point or apex 87 of the locking part 33 is situated under the top layer of the floor panel 1. For clarity's sake, this top layer is indicated in the FIGS. 22-25 only as a single layer.

It should be noted that the combination of features, the lower lip 23-43 extending further than the upper lip 22-42; the locking elements 6 being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip 23-43 which extends distally beyond the upper lip 22-42, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels 1 can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip 23-43 adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface 39 or 73, preferably extends in such a manner that the distance between the upper edge 16 of the panel to the contact surface 39, 73 diminishes between the proximal and distal ends of the sloping contact surface 39, 73, in other words, such that, as represented in FIG. 22, the distance X2 is smaller than the distance X1. This is also the case in FIG. 7.

Still preferably, this portion only starts at a clear distance E1 from the outer edge of upper lip 42.

It is obvious that the coupling parts 22 to 25 can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels 1 are treated at their sides 2-3 and/or 26-27 with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. 22, such impregnation 88 is represented schematically. This treatment can be performed over the complete surface of the sides 2-3 and/or 26-27 or only over specific portions hereof, for example exclusively on the surfaces of the tongue 9 and the groove 10.

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The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts 4-5 and/or 28-29 better keep their shape and strength, even if the floor panels 1 are engaged and disassembled repeatedly. In particular, if the core 8 is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels 1 can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

What is claimed is:

1. A floor covering panel comprising laminated hard floor panel having a wood-based core material comprising a ground wood product and a binding agent unified to form a cured composite;

said floor panel having a decorative layer above said core material;

said floor panel having an upper side, an under side and a perimeter defining first and second pairs of opposed substantially parallel sides;

said first and second pairs of sides both being provided with coupling parts substantially in the form of a tongue and a groove the coupling parts further including locking elements;

said groove of at least said first pair of sides including an upper lip and a lower lip, said lower lip extending distally beyond the upper lip;

said coupling parts cooperating to establish a locking between coupled parts in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panel when the coupling parts of a plurality of ones of said panel are coupled;

said tongue, groove and locking elements being monolithically formed in said composite core;

said coupling parts and locking elements of at least said first pair of sides enabling coupling of two of such panels so that the panels are coupled without play in the plane of the coupled panels;

the coupling parts of said first pair of sides being engageable and coupled by rotational motion relative to each other;

said tongue of said first pair of sides including an upper tongue contact surface and a lower tongue contact surface and an outer peripheral portion of the tongue defined along and between said tongue contact surfaces;

said groove of said first pair of sides including corresponding upper and lower groove contact surfaces which engage the upper and lower tongue contact surfaces of said tongue upon coupling of said coupling parts;

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said lower tongue and groove contact surfaces comprising said coupling parts and locking elements enabling coupling of two of such panels so that the panels are coupled without play in a plane including the coupled panels;

said coupling parts of said first pair of sides upon coupling defining a plurality of separate clearances adjacent at least a portion of said outer peripheral portion of said tongue between said groove and said tongue;

said panel at said first pair of sides comprising at least one intermediate tongue contact surface on said tongue positioned along the outer peripheral portion of said tongue intermediate the upper and lower tongue contact surfaces;

said panel at said first pair of sides comprising at least one intermediate groove contact surface intermediate the upper and lower groove contact surfaces; and

said intermediate tongue and groove contact surfaces of two of said panels cooperating with each other upon coupling of two of said panels.

2. The floor panel according to claim 1, wherein said intermediate contact surface on said groove is disposed proximally relative to a distalmost portion of said upper lip.

3. The floor covering according to claim 1, wherein at least one clearance is defined by said engaged tongue and groove in an area between the respective intermediate tongue and groove contact surfaces and the lower tongue and groove contact surfaces of said engaged tongue and groove.

4. The floor covering panel according to claim 1, wherein the coupling parts of said second pair of sides are engageable and coupled by rotational motion relative to each other about an axis extending parallel to said sides.

5. The floor covering panel according to claim 1, wherein the cured composite core comprises MDF/HDF.

6. The floor covering according to claim 1, wherein the locking elements include a locking protrusion defined on the tongue and a cooperating recess defined in the groove.

7. The floor covering panel according to claim 6, wherein the locking protrusion is defined on an under side of said tongue.

8. The floor covering panel according to claim 6, wherein the locking protrusion is in the form of a local sharp protrusion on the under side of said tongue.

9. The floor covering panel according to claim 6, wherein the cooperating recess formed in the lower lip defines a portion of a clearance between the tongue and the groove that is established when the coupling parts are coupled.

10. The floor covering panel according to claim 7, wherein the locking protrusion provided in the under side of the tongue extends substantially downward from the under side of the tongue and the recess defined in the groove is aligned with the locking protrusion when the coupling parts are coupled.

11. The floor covering panel according to claim 1, wherein the lower lip has a cross-section configuration uniform along the length of the respective edge including the lower lip and has a non-uniform thickness between upper and under sides thereof.

12. The floor covering panel according to claim 11, wherein the lower lip has a thickness adjacent a proximal inner portion of the groove that becomes non-uniformly thinner in the distal direction of the lip.

13. A floor covering panel comprising hard floor panel having a perimeter defining at least a first pair of opposed substantially parallel edges and substantially planar and parallel upper and lower sides;

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said pair of edges being provided with complementary coupling parts substantially in the form of a tongue and groove extending distally along the length of said pair of edges and being formed in the panel material which is located between said planar upper and lower sides;

the coupling parts further including locking elements;

said coupling parts and locking elements cooperating upon coupling of said coupling parts such that coupled ones of said panel are locked in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the edges and parallel to a plane including the panel;

said groove having an upper lip and a lower lip, said lower lip extending distally beyond said upper lip;

said upper lip defining a first clearance below said upper side of said panel and defining an upper lip contact surface adjacent said clearance, said first clearance defining an upper chamber below said upper side and above said tongue upon coupling of cooperating coupling parts;

said lower lip having an inwardly and downwardly inclined lower lip contact surface formed therein;

said tongue having an upper tongue contact surface and a lower tongue contact surface located along the tongue periphery such that the upper and lower tongue contact surfaces respectively abut the upper and lower lip contact surfaces when adjacent panels are coupled; and at least one second chamber being defined between the tongue and groove in the area along the tongue periphery between the respective upper tongue contact surface and the lower tongue contact surface when adjacent panels are coupled.

14. The floor covering panel according to 13, wherein the tongue and groove may be coupled to each other by rotating one coupling part relative to another cooperating coupling part about an axis extending parallel to the respective coupled edges.

15. The floor covering panel according to claim 13, wherein said first clearance is a closed chamber bounded on a lower side by abutting upper lip and upper tongue contact surfaces upon coupling of said coupled parts.

16. The floor covering panel according to claim 15, said upper lip contact surface extending along the panel edge and parallel to the plane of the panel.

17. The floor covering panel according to claim 13, wherein said floor panel is a laminate including an MDF/HDF core.

18. The floor covering panel according to claim 13, wherein said tongue, groove and locking elements of at least said first pair of edges enable two of such panels to be coupled to each other without play in the plane of the coupled panels.

19. The floor covering panel according to claim 13, wherein said second chamber is located in front of the distal end of the tongue tip.

20. The floor covering panel according to claim 13, wherein said locking elements include a locking protrusion at the lower side of the tongue, said second chamber being located below said tongue and in front of said locking protrusion.

21. The floor covering panel according to claim 13, wherein the panel is a laminate and includes a core, and said coupling parts as well as said locking elements are made in one piece with said core.

22. The floor covering panel according to claim 13, wherein the locking elements include a locking protrusion at

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the lower side of the tongue, said protrusion having a convex rounded bottom profile.

23. The floor covering panel according to claim 13, wherein the locking elements include a locking protrusion at the lower side of the tongue, said protrusion having a convex rounded profile and a recess in the lower lip, said recess having a concave rounded profile.

24. The floor covering panel according to claim 23, wherein said rounded profiles are substantially circle-shaped.

25. The floor covering panel according to claim 23, wherein said lower lip contact surface and said lower tongue contact surface comprise said locking elements.

26. The floor covering panel according to claim 23, wherein said locking protrusion, seen in cross-section, extends over a substantial portion of the lower side of the tongue.

27. A floor covering panel for forming a floating floor: said floor panel having a core material and a decorative layer material above said core material;

said floor having a thickness between 0.5 and 1.5 cm;

said floor panel having an upper side, an under side and a perimeter defining first and second pairs of opposed substantially parallel sides;

said first and second pairs of sides both being provided with coupling parts, the coupling parts further including locking elements;

said groove of at least said first pair of sides including an upper lip and a lower lip, said lower lip extending distally beyond the upper lip;

said coupling parts of at least said first pair of side cooperating to establish a locking between coupled parts in a direction perpendicular to the plane of the

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panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panel when the coupling parts of a plurality of ones said panel are coupled;

said tongue, groove and locking elements or said first pair of sides being formed in one piece with the panel, the coupling parts of said first pair of sides being engageable and coupled by rotational motion relative to each other;

said locking elements of at least said first pair of sides including a locking protrusion defined on the tongue and a cooperating recess defined in the groove;

said locking protrusion being in the form of a local sharp protrusion on the under side of said tongue;

said protrusion in one direction laterally being delimited by a first surface, said first surface acting as a locking element preventing relative movement between coupled panels in a direction parallel to a plane including the coupled panels;

said protrusion, in the opposite direction being limited by a second surface; and

said tongue and groove defining a clearance which is located directly adjacent said second surface and below the tongue portion which is located distally beyond said protrusion.

28. The floor covering panel according to claim 27, wherein the core material is MDF or HDF.

29. The floor covering panel according to claim 27, wherein said coupling parts of said at least first pair of sides are configured so that when coupled they are free of play.

* * * * *

EXHIBIT E

(12) **United States Patent**
Moriau et al.

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(45) **Date of Patent:** **Oct. 18, 2005**

(54) **FLOOR PANELS WITH EDGE CONNECTORS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 112 days.

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(58) **Field of Search** 52/403.1, 480, 52/582.1, 591.3

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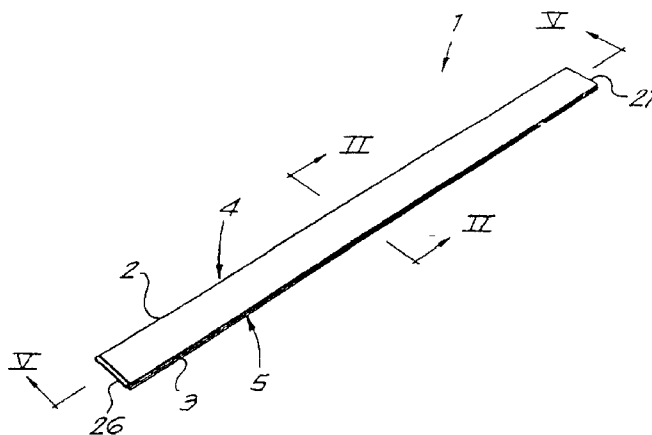
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(57)

ABSTRACT

A floor covering panel made of a hard laminated assembly including a wood-base core includes coupling parts formed in one piece with the core, wherein the coupling parts provide locking elements for preventing the drifting apart of coupled panels in directions perpendicular to the mutual edges along which the panels are coupled and perpendicular to the mutual edges and parallel to a plane including coupled floor panels, and further wherein the mechanical locking elements include an upper surface portion of the tongue extending toward the panel upper side and cooperating with a portion of an upper wall of the groove in which the tongue is coupled in locking relationship, and wherein a portion of the upper surface of the tongue includes the surface sloping away from the panel upper side in a distal direction of the tongue at the distal upper end area of the tongue.

8 Claims, 10 Drawing Sheets



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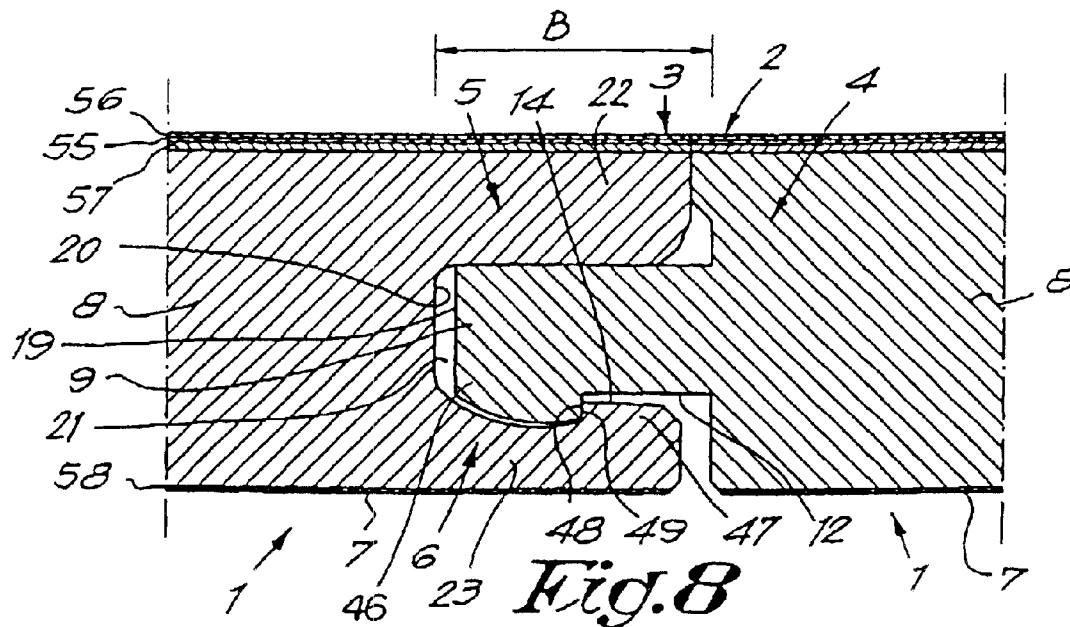
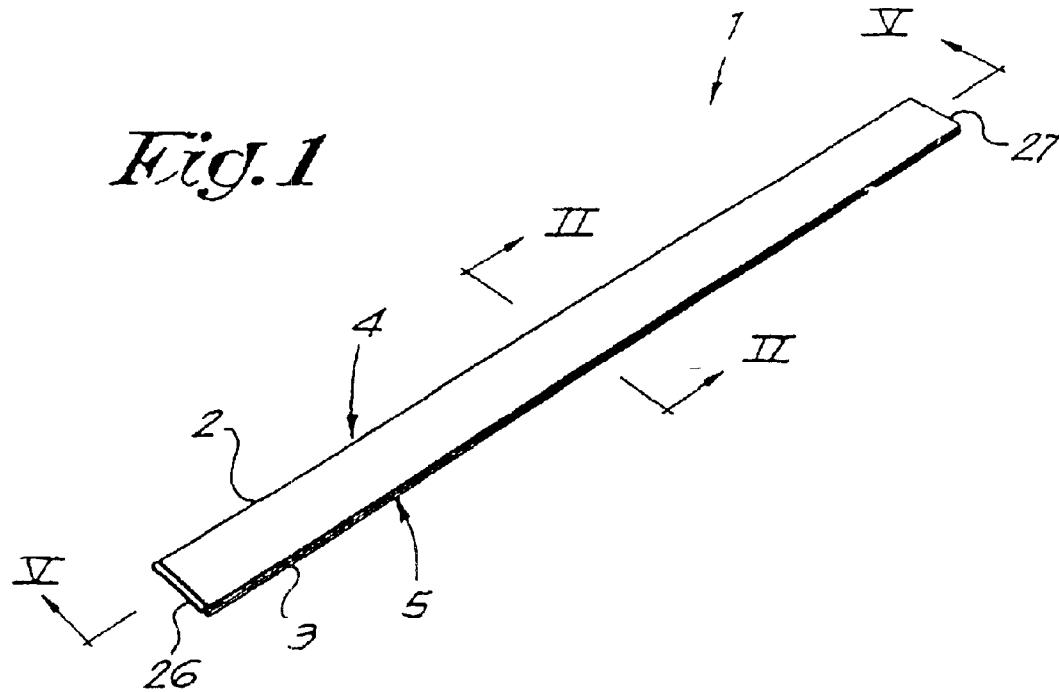
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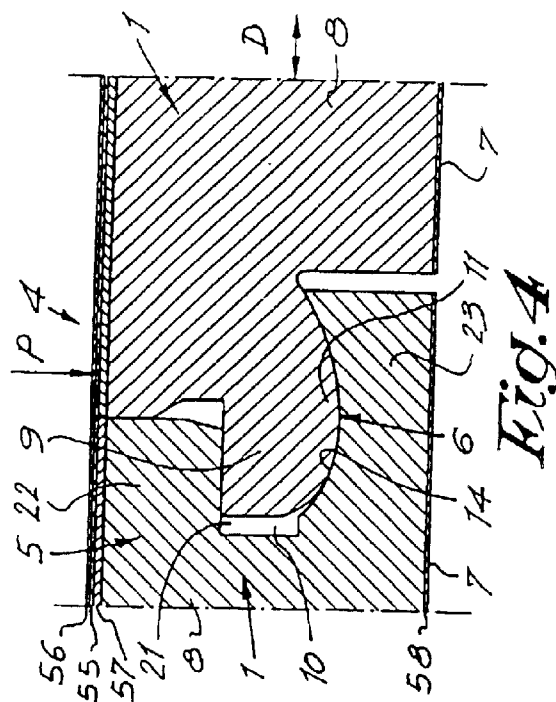
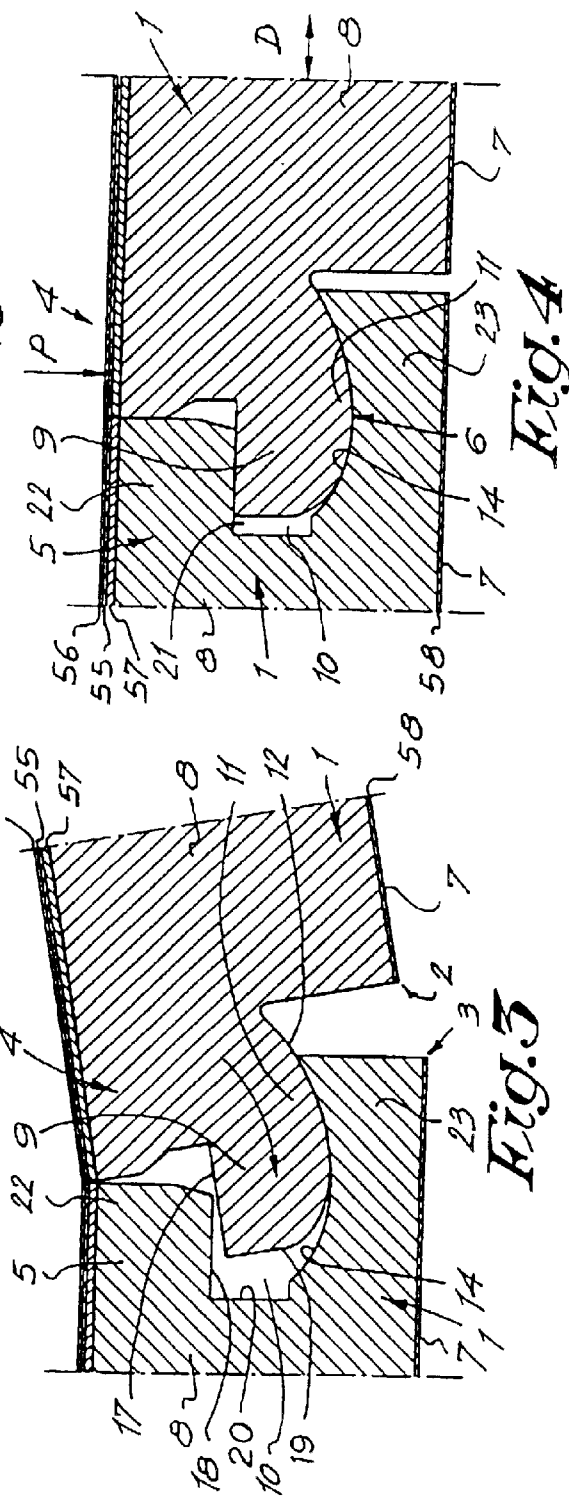
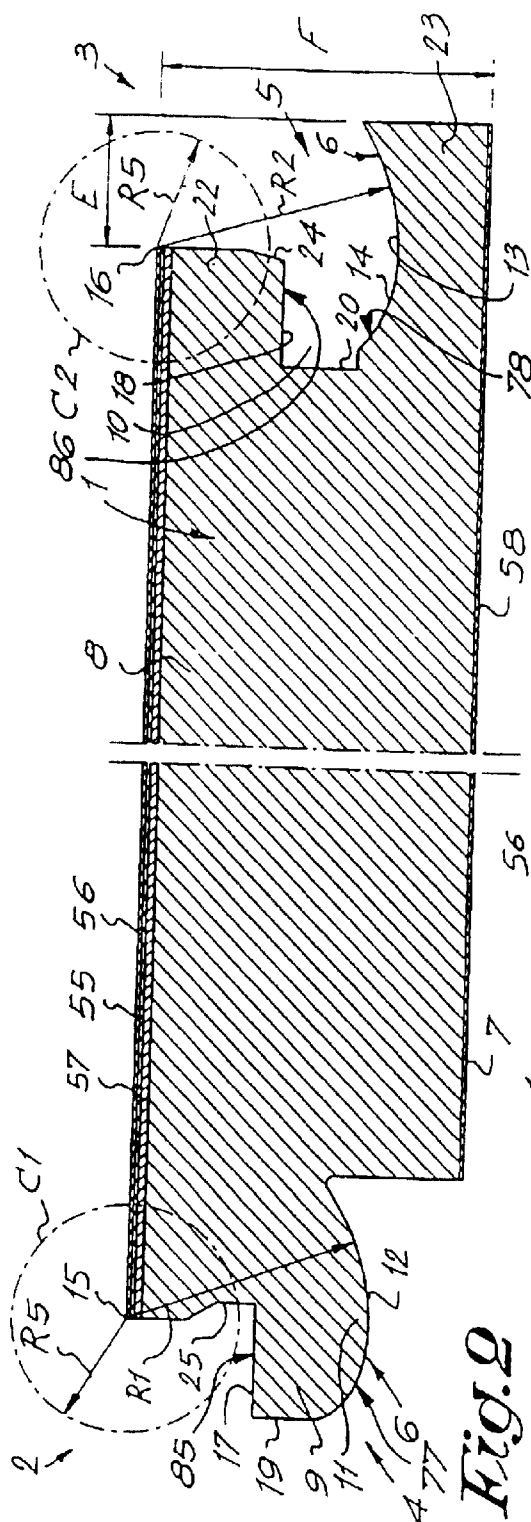
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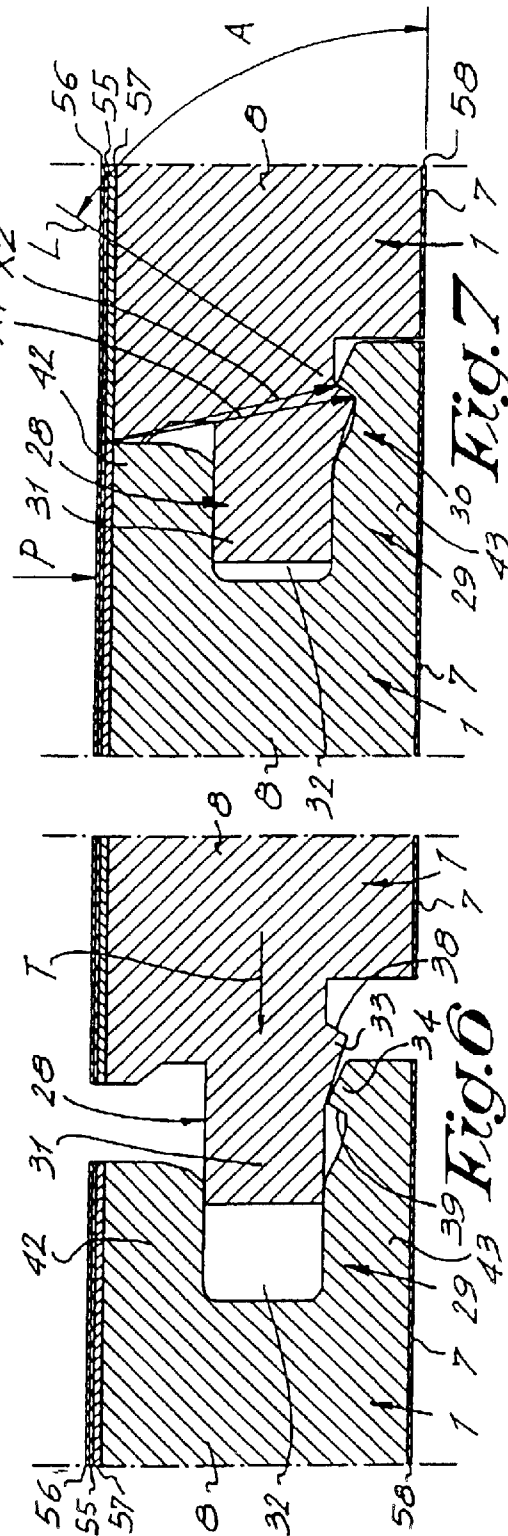
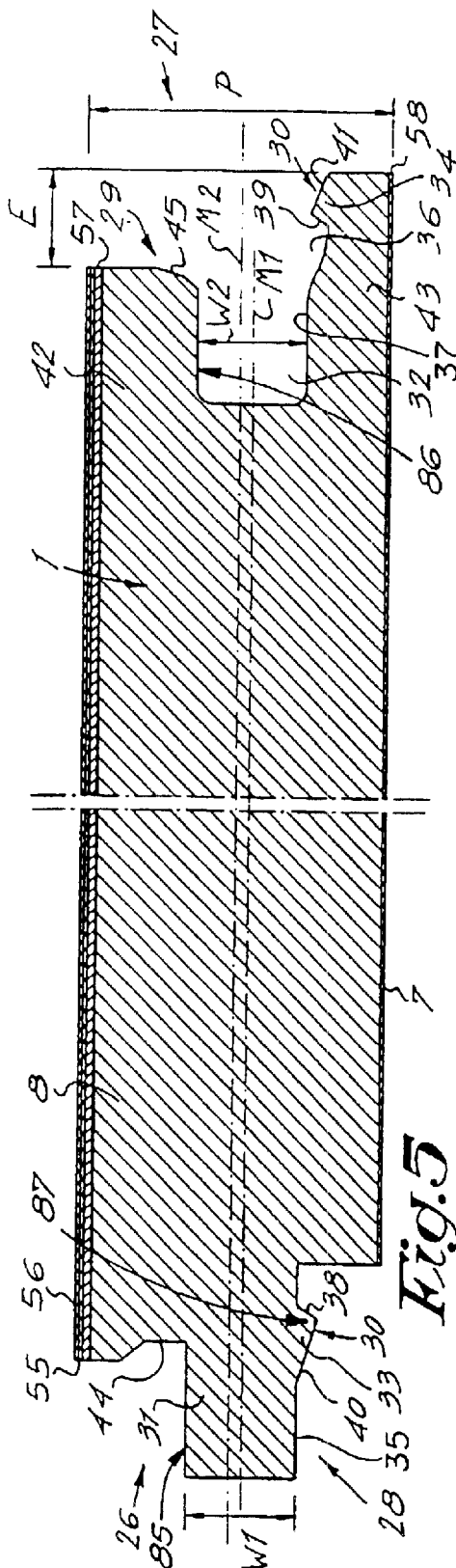
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Fig. 1





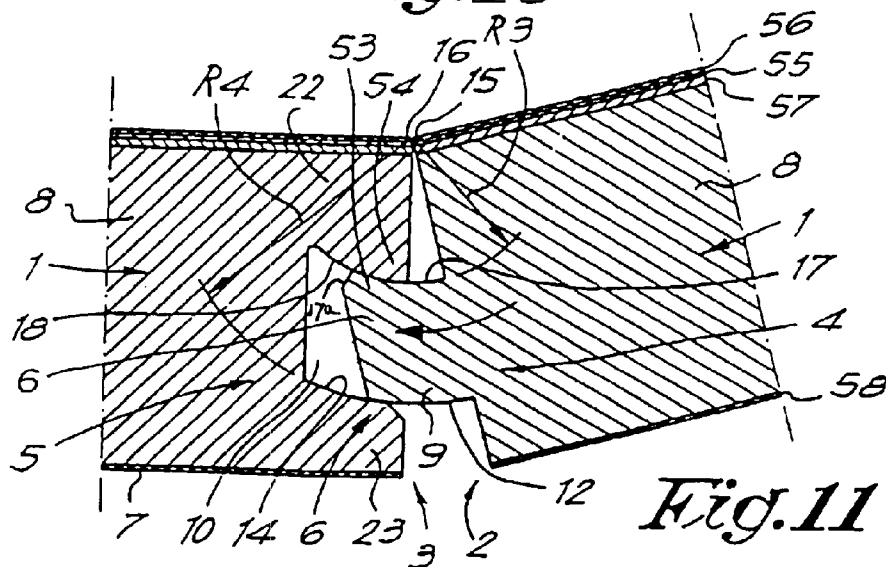
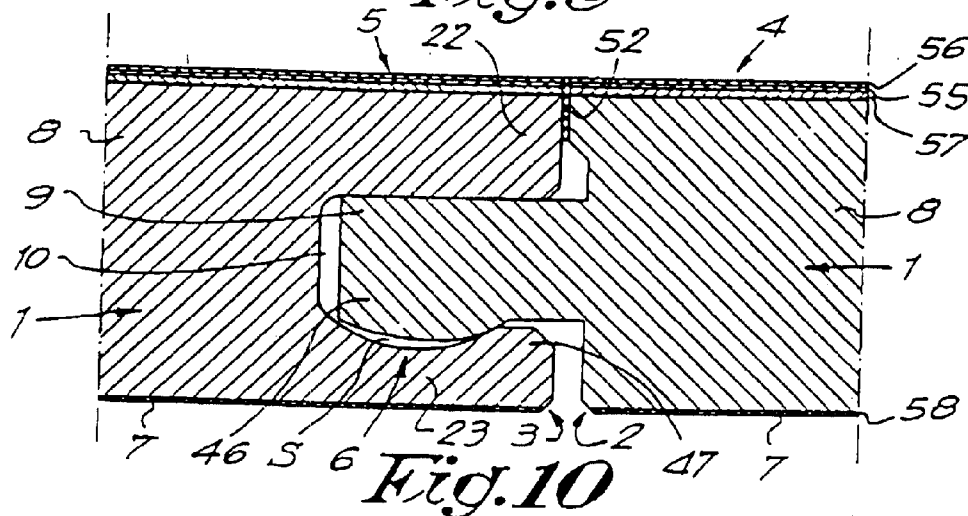
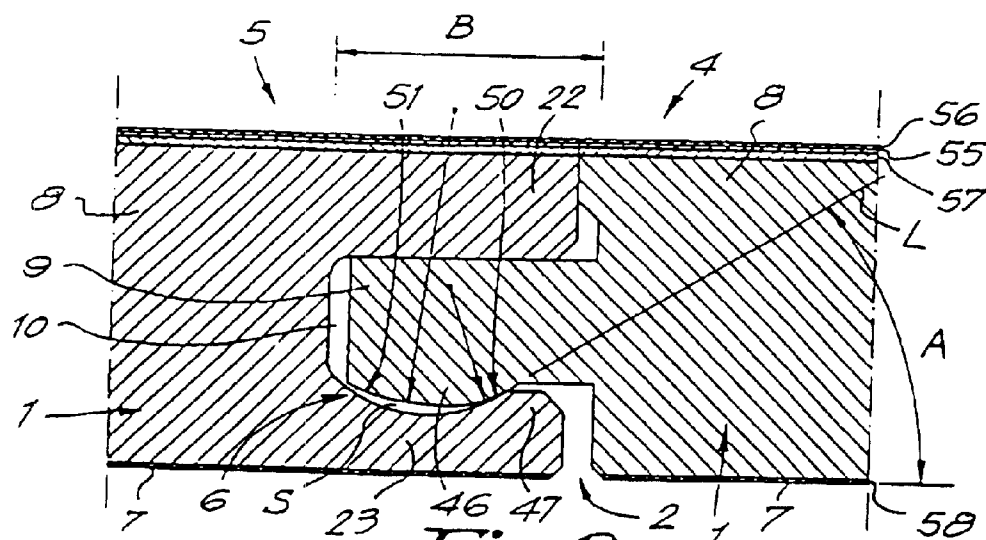


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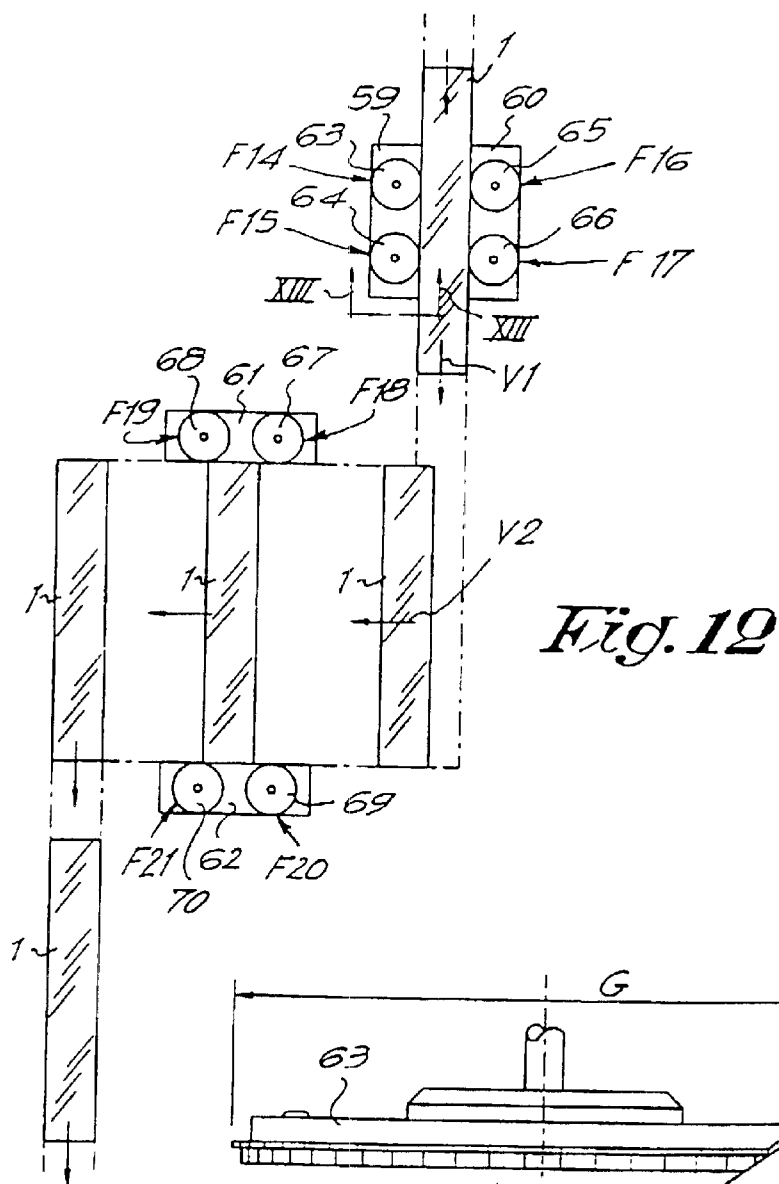


Fig. 12

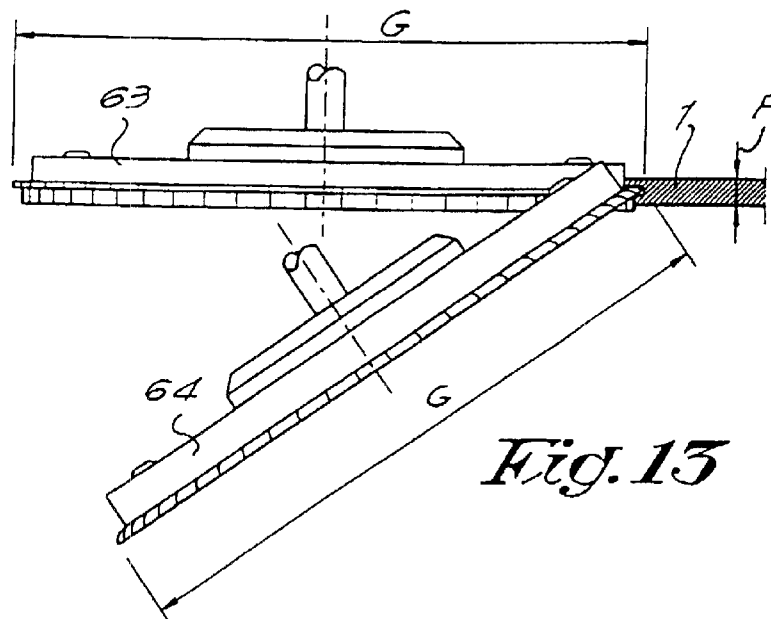


Fig. 13

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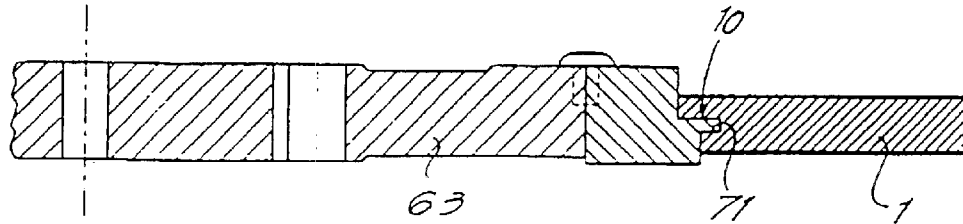


Fig. 14

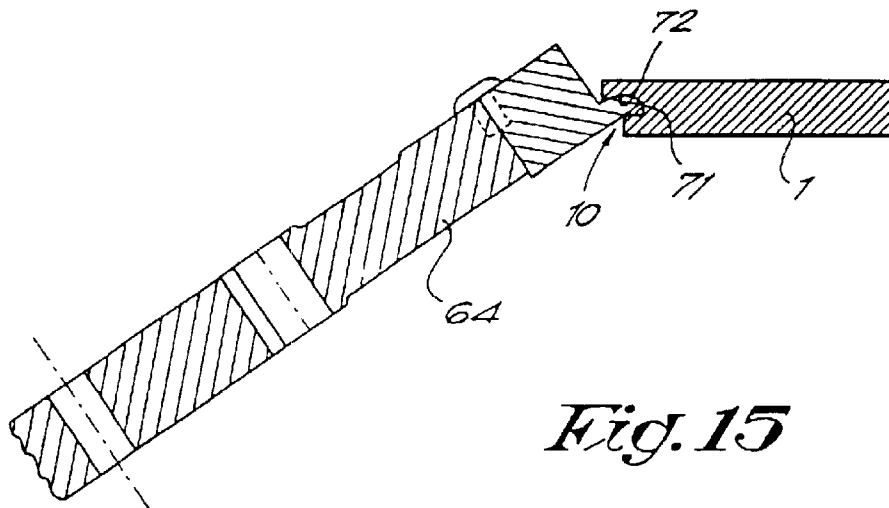


Fig. 15

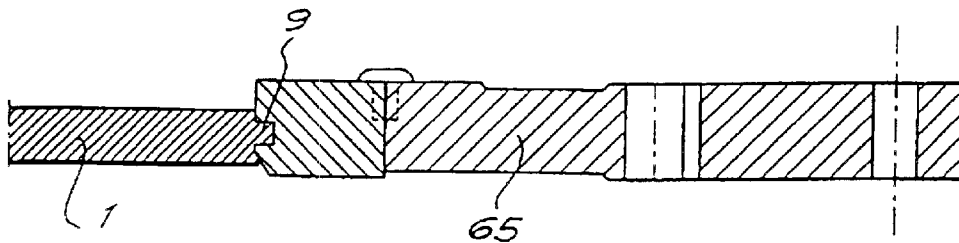


Fig. 16

Fig. 17

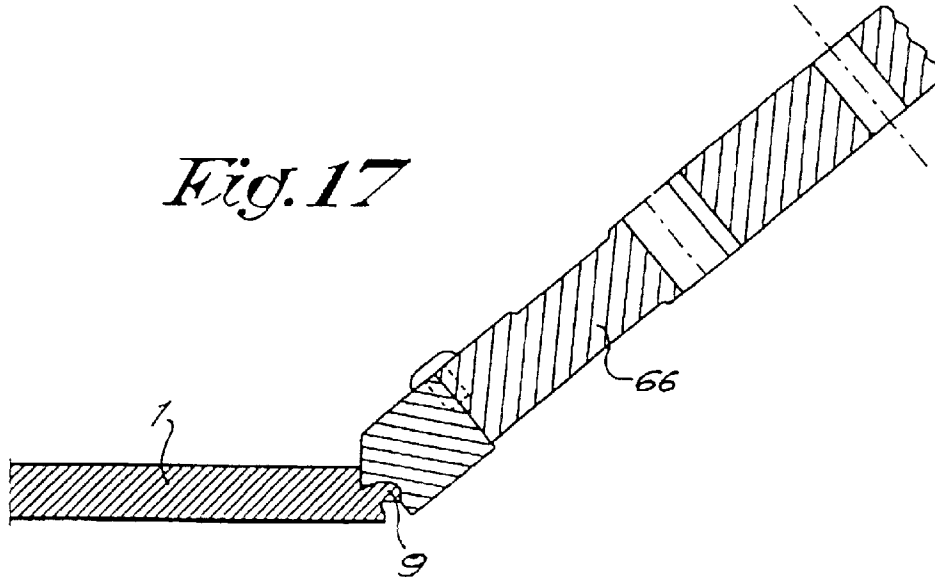


Fig. 18

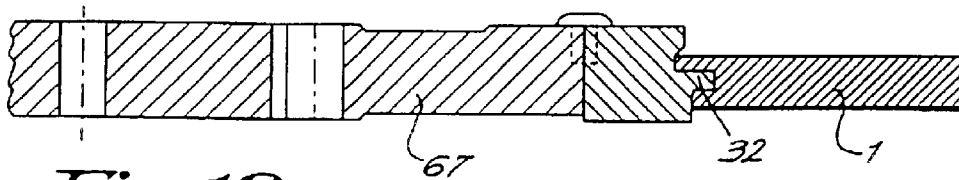
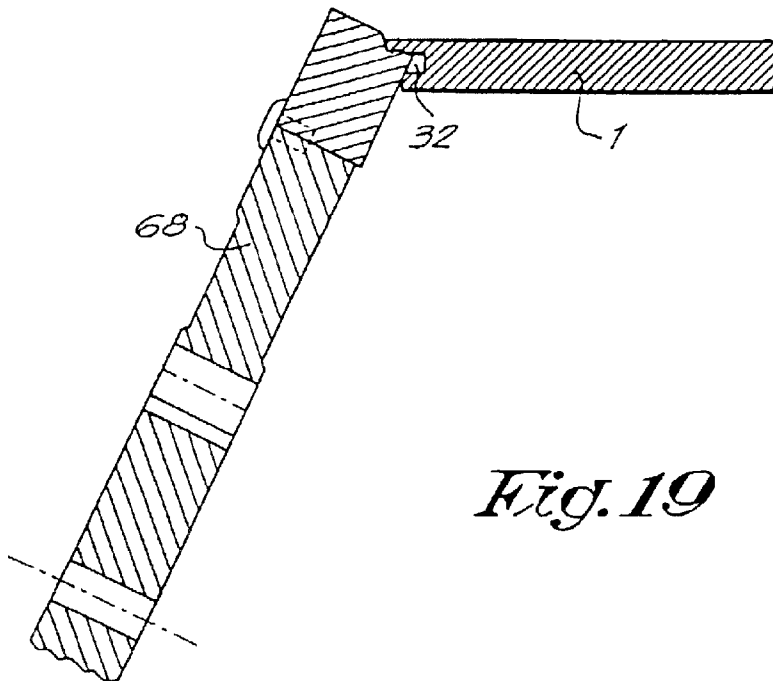


Fig. 19



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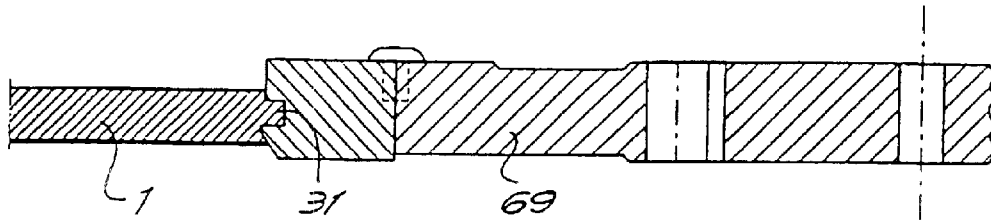


Fig. 20

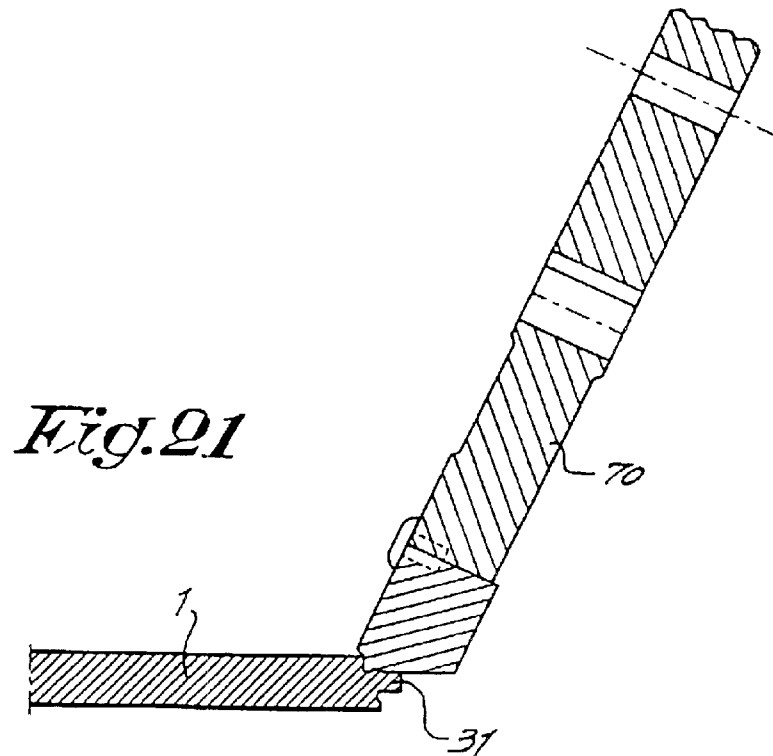


Fig. 21

Fig. 22

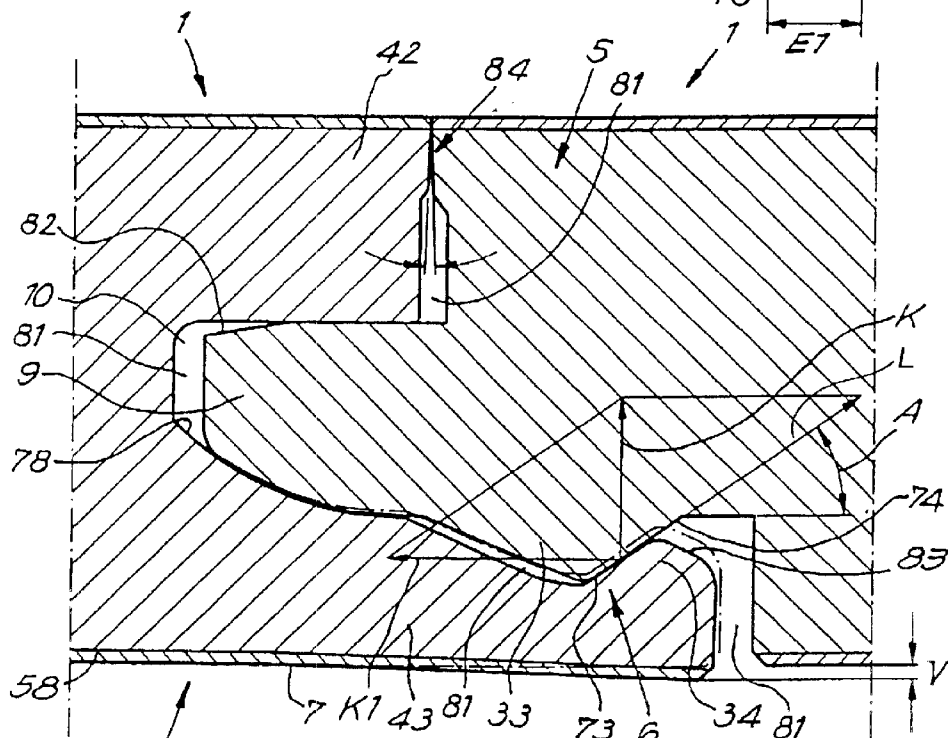
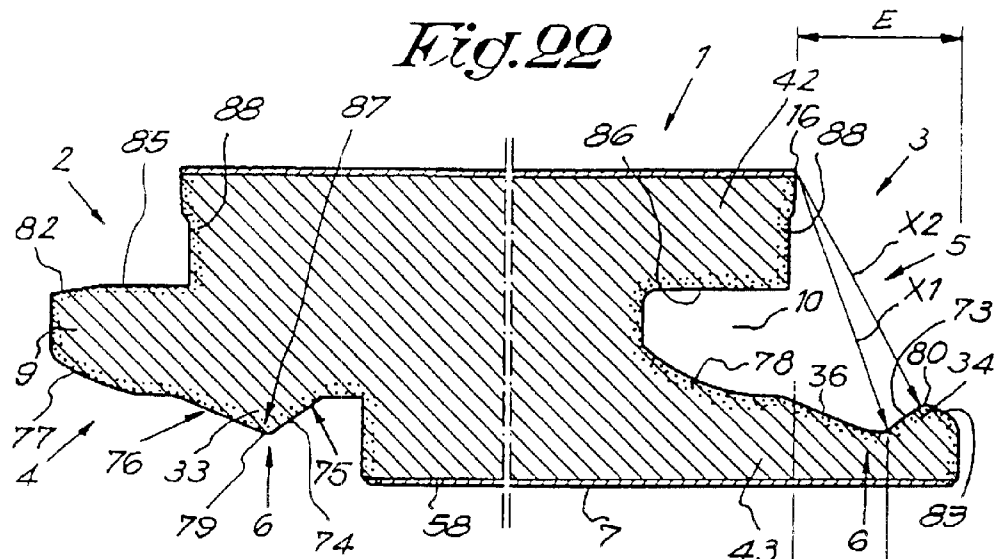
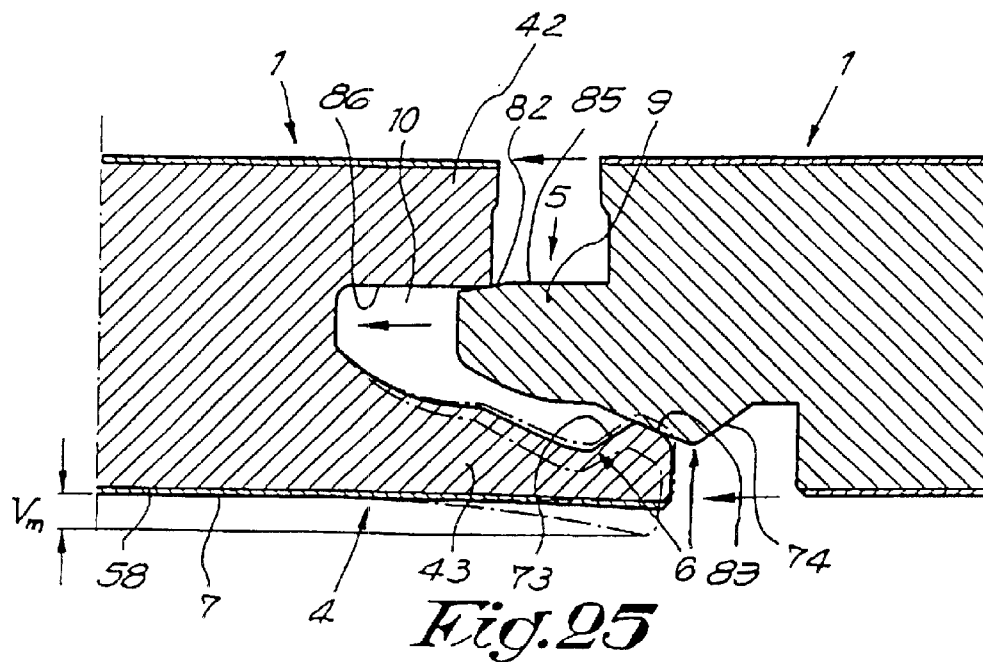
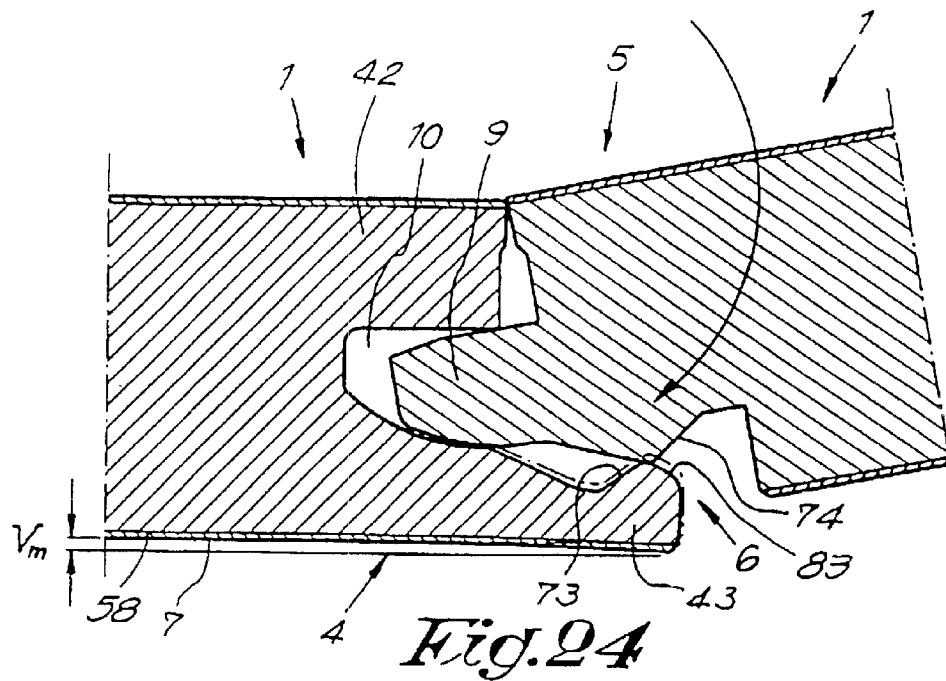


Fig. 25



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FLOOR PANELS WITH EDGE CONNECTORS**RELATED APPLICATION DATA**

This application is a continuation of application Ser. No. 09/471,014, filed Dec. 23, 1999 now U.S. Pat. No. 6,490,836; which is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997, now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION**1. Field of the Invention**

This invention relates to floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE

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3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into

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a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles (fibers) and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

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In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. 1 represents a floor panel of a floor covering according to the invention;

FIG. 2, on a larger scale, represents a cross-section according to line II—II in FIG. 1;

FIGS. 3 and 4 represent how two floor panels with coupling parts according to FIG. 2 match into each other;

FIG. 5, on a larger scale, represents a cross-section according to line V—V in FIG. 1;

FIGS. 6 and 7 represent how two floor panels with coupling parts according to FIG. 5 match into each other;

FIGS. 8 to 11 represent a number of variants of coupling parts of floor panels according to the invention;

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FIG. 12 schematically represents how the floor parts can be provided with coupling parts;

FIG. 13 represents a cross-section according to line XIII—XIII in FIG. 12;

FIGS. 14 to 21, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. 12 with arrows F14 to F21;

FIG. 22 represents a floor panel according to the invention;

FIG. 23, on a larger scale, represents the coupling of two floor panels of FIG. 22;

FIGS. 24 and 25 represent two manners of coupling floor panels according to FIG. 22 to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels 1, for example, such as a laminated panel as shown in FIG. 1.

These floor panels 1 can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. 1, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is, at least at the edges of two opposite sides 2-3, provided with coupling parts 4-5 which permit two adjacent identical floor panels 1 to be coupled to each other.

According to the invention, the coupling parts 4-5, as represented in the FIGS. 2 to 4, are provided with integrated mechanical locking parts or locking elements 6 which prevent the drifting or sliding apart of two coupled floor panels 1 in a direction D perpendicular to the respective sides 2-3 and parallel to the underside 7 of the coupled floor panels 1; the coupling parts 4-5 and the locking elements 6 are formed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two subsequent floor panels 1 can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel 1 can be laterally inserted into the previous; and the coupling parts 4-5 preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels 1 with an elongated shape, as represented in FIG. 1, the respective coupling parts 4-5 are located at the longitudinal sides 2-3.

The coupling parts 4-5 can be realized in various forms, although the basic forms thereof will always be formed by a tongue 9 and a groove 10.

In the form of embodiment of FIGS. 2 to 4, the related floor panel 1 is provided with coupling parts 4-5 and locking means or locking elements 6 which allow two floor panels 1 to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements 6 consist of a first locking element 11, formed by a protrusion with a bent round shape at the lower side 12 of the tongue 9, and a second locking element 13 (shown in FIG. 2), formed by a recess with a bent hollow or downwardly concave shape in the lower wall 14 of the groove 10.

The locking elements 11-13 ensure that two floor panels 1 which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

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In order to enable two floor panels 1 to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side 12 of locking means or locking elements 6 has a curvature with a radius R1, the center of which coincides with the respective upper edge 15 of the floor panel 1, whereas the lower wall 14 of the locking part 5 has a curvature with a radius R2 which is equal to the radius R1, but its center coincides with the respective upper edge 16. Radii R1 and R2 may also be applied which are larger or smaller than the distance to the upper edge 15, 16 respectively, and/or which differ from each other in size.

The upper side 17 of the tongue 9 and the upper wall or side 18 of the groove 10 are preferably flat and preferably are located in the horizontal plane.

The inner side 20 of the groove 10 and the front side 19 of the tongue 9 of the two interlocked floor panels 1 preferably do not fit closely against each other, such that an intermediate space 21 is created between them into which possible dust remainders or such can be pushed away by means of the tongue 9.

The tongue 9 and the groove 10 preferably have shapes which are complementary to each other, such that the tongue 9 in the engaged condition of two identical floor panels 1 precisely sits against the upper wall 18 and the lower wall 14 of the groove 10, whereby a pressure P, exerted against the upper lip 22, is received or reacted not only by this lip 22, but by the complete structure, because this pressure can be transmitted through the tongue 9 and the lower lip 23 to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer 24 on lip 22 and a recess 25 can be provided, as represented in FIGS. 2 to 4, as a result of which the subsequent floor panels 1 can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. 5 to 7, the floor panels 1 according to the invention can also, along the sides 26-27 which are at a right angle to the sides 2-3, be provided with coupling parts 28-29 which have locking elements 30, too. The coupling parts 28-29 are preferably also realized in the shape of a tongue 31 and a groove 32. Hereby, the locking elements 30 do not have to be of the same nature as the locking elements 6.

Preferably, at the sides 26-27 locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. 6 and 7. To this aim, the locking elements 30 consist of a snap-together connection with locking elements 33 and 34 which grip behind each other.

As represented in FIGS. 5 to 7, the locking element 33 preferably consists of a protrusion of the lower side 35 of the tongue 31 which can be located in a recess 36 in a lower lip 43 extending distally from the lower wall 37 of the groove 32. The locking element 34 is formed by the upward directed part or protrusion which defines the distally outer end of recess 36.

In this case, the locking elements 33-34 have contact surfaces 38-39 which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces 38-39, hereby forms an angle A sloping inwardly and

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downwardly from an outer region to an inner region relative to the underside 7, which angle is smaller than 90°.

The locking elements 33-34 preferably are provided with inclined portions 40 and 41 which, when two floor panels 1 are engaged, cooperate with each other in such a manner that the locking elements 33-34 can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. 6 and 7).

The thickness W1 of the tongue 31 preferably is equal to the width W2 of the groove 32, such that compression pressure P applied to the upper lip 42 is reacted by the tongue 31 which, in its turn, then is reacted by the lower lip 43.

Analogous to the chamfer 24 and recess 25, a recess 44 and a chamfer 45 are provided also at the edges 28-29.

It is noted that such a snap-together coupling can also be applied at the edges 2-3. Hereby, this can be a snap-together coupling analogous to these of FIGS. 5 to 7, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. 8 and 9. Contrary to the locking elements 33-34 which consist of rather local protrusions, in the forms of embodiment of FIGS. 8 and 9 use is made of locking elements 46-47 which, in comparison to the total width B of the coupling, extend over a rather large distance.

In this case, the locking elements 46-47 are also provided at the lower side 12 of the tongue 9 and the lower wall 14 of the groove 10.

According to FIG. 8, the locking elements 46-47 have contact surfaces 48-49 which are at an angle with the plane of the floor panel 1. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. 9, the locking elements 46-47 possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements 46-47 hereby consist of curved surfaces. The common plane of tangency L forms an angle A which is smaller than 90°, and more preferably is smaller than 70°.

In this manner, the locking element 46 preferably has two portions with a different curvature, on one hand, a portion 50 with a strong curvature and, on the other hand, a portion 51 with a weak curvature. The portion 50 with the strong curvature provides for the formation of a firm coupling. The portion 51 with the weak curvature facilitates the coupling parts 4-5 to be brought into each other easily. The intermediate space S forms a chamber which offers space for dust and the like which, when engaging two floor panels 1, inevitably infiltrates there.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. 7 to 9, preferably the tongue 9-31 has a shape that thickens from below, which then can cooperate with a widened portion in the groove 10.

In FIG. 10, a variant is represented whereby at least at the level of the upper edges 15-16, a sealing material 52 is provided, as a result of which a watertight sealing can be assured. This sealing material 52 may consist of a strip or covering which is provided previously at the floor panel 1, either at one or both upper side edges 15-16.

In FIG. 11, a further variant is represented, whereby the locking element 6 is formed by an upward directed portion 53 at the tongue 9, which as a result of a turning movement of the panel, is brought behind a downward-directed portion

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54 on the upper wall 18. More particularly, this is obtained by forming the tongue upper side surface portion (first surface portion) 17 and the groove upper wall 18 with a curvature R3, the center of which is situated at the upper side edges 15-16, and forming the lower side 12 and the lower wall 14 with a radius R4, the center of which is also situated at the upper side edges 15 and 16, respectively. These radii R3-R4 can be chosen otherwise, too. The tongue upper side also includes a planar surface 17a that slopes away from the upper side of the panel 1 towards a distal direction of the tongue.

In general, according to the invention, the difference between, on one hand, the radius R1, R3 respectively, and, on the other hand, the radius R2, R4 respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle C1, C2 (see FIG. 2) respectively, which extends with a radius R5 of 3 mm centered at upper side edge 15, 16 respectively.

Finally is noted that, according to the invention, the lower lip 23-43, as represented in FIGS. 2 to 7, can be formed distally longer than the upper lip 22-42. This has an advantage that the coupling parts 4-5-28-29 can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels 1, because each subsequent floor panel 1 during installation can be placed upon the protruding lower lip 23-43, as a result of which the tongue 9-31 and the groove 10-32 automatically are positioned in front of each other.

The embodiments wherein the lower lip 23 is equal to or distally shorter than the upper lip 22, in their turn, offer the advantage that no protruding lip 23 remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference E between the distally outer edge of the upper lip 22-42 and the distally outer edge of the lower lip 23-43, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove 10, should preferably be kept smaller than one time the total thickness F of the floor panel 1. For stability's sake, normally this total thickness F shall never be less than 5 mm.

The small dimension of the difference E offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line M1 through the tongue 9 and the groove 10 is situated lower than the center line M2 of the floor panel 1, such, that the upper lip 22-42 is thicker than the lower lip 23-43. In first instance, this is essential in this kind of connection, because then it is the lower lip 23-43 which bends, whereby the upper side of the floor panel 1 is kept free of possible deformations.

As explained in the introduction, for the core 8 a material is chosen from the following series:

a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;

a product based on synthetic material;
chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. 2 to 11, such laminated flooring preferably consists of a core 8 made of

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MDF medium density fiberboard board, HDF high density fiberboard board or similar, whereby at least at the upper side of this core 8 one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer 55 and a protective top layer 56. The decorative layer 55 is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer 56 preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer 57 upon which the decorative layer 55 is provided.

Preferably, also a backing layer 58 shall be applied at the underside 7, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel 1. This backing layer 58 may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. 12, the tongue 9 and the groove 10, and preferably also the tongue 31 and the groove 32 are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels 1 preferably shall be displaced by means of two sequential perpendicular movements V1 and V2, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices 59-60, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices 61-62. During these processing, the floor panels 1 preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue 9-31 and groove 10-32 are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel 1.

This is illustrated in FIGS. 13, 14 and 15, wherein it is represented how a groove 10 is realized by means of two milling cycles by means of two milling cutters 63 and 64. FIGS. 16 and 17 represent how the tongue 9 is shaped by means of milling cutters 65 and 66.

The FIGS. 18-19 and 20-21 represent similar views showing how the groove 32 and the tongue 31 are shaped by means of milling cutters 67-68 and 69-70, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter 63 of FIG. 14 determines the final shape of the lower flank 71 of the groove 10, whereas the milling cutter 64 determines the final shape of the upper flank 72.

As mentioned in the introduction, preferably milling cutters 63 to 72 shall be used, having diameters G which are at least 5 times, and even better at least 20 times larger than the thickness F of the floor panels 1.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. 22 to 25, a particularly preferred form of embodiment of a floor panel 1 according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

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An important characteristic herein consists in that the coupling parts 4-5 are provided with locking elements 6 which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels 1 are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip 43, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels 1 being forced towards each other. The resultant bending V, as well as the tension force K_1 are indicated in the enlargement view of FIG. 23.

In order to obtain the tension force K pressing together the engaged floor panels 1, the bendable portion, in this case the lip 43, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface 73 which preferably can cooperate with a corresponding contact surface 74 on tongue 9. These contact surfaces 73-74 are similar to the aforementioned contact surfaces 39-38 and also similar to the inclined portions of the lower lip of FIGS. 2 to 4.

In the FIGS. 2 and 5, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. 23 can be realized.

Due to, on one hand, the contact along the angle A, and, on the other hand, the fact that a tension force K is created, a compression force component K_1 is produced, as a result of which the floor panels 1 are drawn against each other in compression.

Preferably, the angle A of the mutual plane of tangency of contact surfaces 73-74 relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force K is realized, an angle A of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels 1 and, on the other hand, to ensure that the floor panels 1 can easily be engaged and respectively disassembled.

Although the pressing or compression force component K_1 preferably is delivered by the aforementioned lip 43, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending V is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending V of the lip 43 only produces local bending of the underlayer.

Due to the fact that the lip 43 is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts 4-5, including the locking elements 33-34, and preferably the complete core 8, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

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According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. **22** to **25** consists in that the floor panels **1** can be selectively engaged by means of a turning movement, as represented in FIG. **24**, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. **25**, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending *V_m* results in the coupling parts, more particularly in the lip **43**, which bending *V_m* is less pronounced, if not nonexistent, as in the FIGS. **2** to **4**, in comparison to the bending *V_m* which results when the floor panels **1** are engaged by means of shifting them towards each other, as in FIG. **15**.

The advantage of this consists in that the floor panels **1** can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel **1** can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts **4-5** shown in FIGS. **22** to **25** can also be used for the coupling parts **28-29** of the short sides of the panels.

According to the invention, in the case that the four sides **2-3-26-27** are provided with coupling parts **4-5-28-29**, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels **1**, for example, as represented in FIG. **1**, the locking at the small sides **26-27** preferably shall be more pronounced than at the longitudinal sides **2-3**. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces **73-74** with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element **33**, is bounded by at least two portions **75-76** (shown in FIG. **22**), respectively a portion **75** with a strong (steep) inclination which provides for the locking, and a portion **76** with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. **22** to **25**, these portions **75-76** are formed by straight planes, but, as already described with reference to FIG. **9**, use can also be made of curved portions **50-51**. In FIG. **5**, these are the contact surface **38** and the inclined portion **40**.

In the preferred form of the invention, the floor panels **1** comprise coupling parts **4-5** and/or **28-29** exhibiting one of the following or the combination of two or more of the following features:

a curvature **77** (shown in FIG. **22**) at the lower side of the tongue **9** and/or a curvature **78** at the lower lip **43** which form a guidance when turning two floor panels **1** into each other, with the advantage that the floor panels **1** can be engaged into each other easily during installation;

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roundings **79-80** at the edges of the locking elements **33-34**, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels **1** and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;

dust chambers **81**, or spaces **21** as in FIG. **4**, between all sides, directed laterally towards each other, of the engaged floor panels **1**, with the advantage that inclusions which get between the floor panels **1** during the engagement do not exert an adverse influence upon good engagement;

a shaping of the tongue **9** which is such, for example, by the presence of a chamfer **82**, that the upper side of the tongue **9** becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip **42** when the floor panels **1** are pushed towards each other in substantially the same plane, as indicated in FIG. **25**, with the advantage that the front extremity or end of the tongue **9** does not press against the front side of the upper lip **42** or the front edge of the bottom lip **43** when the floor panels are pushed towards each other in the same plane;

a ramp surface **83**, hereinbefore also called inclined portion **41**, formed at the distally outer end of the lower lip **43**, with the advantage that the locking elements **33-34** shift smoothly over each other and that the lower lip **43** is bent uniformly;

in the engagement direction only one important contact point which is formed by a section **84** at the location of the upper side edges of the floor panels **1**, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels **1** and that the development of openings between the floor panels **1** is counteracted;

contact surfaces **85-86**, more particularly abutment surfaces, formed by the upper side of the tongue **9** and the upper side of the groove **10** which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels **1**, as well as contact surfaces cooperating with each other, formed by curvatures **77-78**, with the advantage that no mutual displacement in height between two engaged floor panels **1** is possible, even if the insertion depth of the tongue **9** into the groove **10** should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. **22** to **25**, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. **2** to **11**, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. **5** to **7** and **22** to **25**, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element **6**, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip **23-43** which extends beyond the distal edge of the upper lip **22-42**, more particularly, the lowermost point **87** of the locking part **33** is situated under the top layer of the floor panel **1**. For clarity's sake, this top layer is indicated in the FIGS. **22-25** only as a single layer.

It should be noted that the combination of features, the lower lip **23-43** extending further than the upper lip **22-42**; the locking elements **6** being formed at least by means of a

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contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip **23-43** which extends distally beyond the upper lip **22-42**, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels **1** can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip **23-43** adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface **39** or **73**, preferably extends in such a manner that the distance between the upper edge **16** of the panel to the contact surface **39**, **73** diminishes between the proximal and distal ends of the sloping contact surface **39**, **73**, in other words, such that, as represented in FIG. **22**, the distance **X2** is smaller than the distance **X1**. This is also the case in FIG. **7**.

Still preferably, this portion only starts at a clear distance **E1** from the outer edge of upper lip **42**.

It is obvious that the coupling parts **22** to **25** can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels **1** are treated at their sides **2-3** and/or **26-27** with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. **22**, such impregnation **88** is represented schematically. This treatment can be performed over the complete surface of the sides **2-3** and/or **26-27** or only over specific portions hereof, for example exclusively on the surfaces of the tongue **9** and the groove **10**.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts **4-5** and/or **28-29** better keep their shape and strength, even if the floor panels **1** are engaged and disassembled repeatedly. In particular, if the core **8** is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels **1** can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

What is claimed is:

1. A floor covering panel comprising:

an upper side and an under side;

said panel formed as a hard laminated assembly including a wood-base core comprising a ground wood product and a binding agent unified to form a cured composite; at least one decorative layer on the upper side of the panel and a backing layer on the underside of the panel;

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said panel having at least one pair of opposed side edges including coupling parts formed to cooperate with each other to couple similar panels along mutual side edges when brought together;

said coupling parts comprising substantially a tongue, a groove and mechanical locking elements all formed in one piece with the core of the panel;

said locking elements arranged so that they prevent the drifting apart of coupled panels in a direction perpendicular to the mutual edges along which the panels are coupled and in a direction perpendicular to said mutual edges and parallel to a plane including coupled panels;

said mechanical locking elements comprising at least a first upper surface portion of said tongue extending toward said panel upper side, and a portion of an upper wall of said groove formed to cooperate in locking relationship in a direction perpendicular to the mutual edges along which the panels may be coupled with at least a portion of the first upper surface portion of said tongue when similar panels are coupled and said tongue including a second upper surface portion disposed at a distal upper end of the tongue, said second upper surface portion comprising a planar surface sloping away from said panel upper side in a distal direction of the tongue.

2. The floor covering panel according to claim **1**, wherein the panel includes two opposed pairs of side edges, all of said side edges including a coupling part, with opposed edges having one of a tongue and a groove but not both a tongue or a groove.

3. A floor covering panel comprising:

an upper side and an under side;

said panel formed as a hard laminated assembly including a wood-base core comprising a ground wood product and a binding agent unified to form a cured composite; at least one decorative layer on the upper side of the panel and a backing layer on the underside of the panel;

said panel having at least one pair of opposed side edges including coupling parts formed to cooperate with each other to couple similar panels along mutual side edges when brought together;

said coupling parts comprising substantially a tongue, a groove and mechanical locking elements all formed in one piece with the core of the panel;

said locking elements arranged so that they prevent the drifting apart of coupled panels in a direction perpendicular to the mutual edges along which the panels are coupled and in a direction perpendicular to said mutual edges and parallel to a plane including coupled panels;

said mechanical locking elements comprising at least a first upper surface portion of said tongue extending toward said panel upper side, and a portion of an upper wall of said groove formed to cooperate in locking relationship in a direction perpendicular to the mutual edges along which the panels may be coupled with at least a portion of the first upper surface portion of said tongue when similar panels are coupled and said tongue including a second upper surface portion disposed at a distal upper end of the tongue, said second upper surface portion comprising a planar surface sloping away from said panel upper side in a distal direction of the tongue;

wherein said first upper surface portion of said tongue and said cooperating upper wall portion of said groove are arcuately curved.

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4. The floor covering panel according to claim 3, wherein the arcuate curvature is a circular segment.

5. The floor covering panel according to claim 1, wherein the coupling parts are configured to couple similar panels together without play.

6. The floor covering panel according to claim 5, wherein the panel includes two opposed pairs of side edges, all of said side edges including a coupling part, with opposed edges having one of a tongue and a groove but not both a tongue or a groove.

7. The floor covering panel according to claim 5, wherein the coupling parts are configured to couple similar panels together without play.

8. A floor covering panel comprising:

an upper side and an underside;

said panel formed as a hard laminated assembly including a wood-base core made of a material selected from the group consisting of MDF and HDF;

at least one decorative layer on the upper side of the panel and a backing layer on the underside of the panel;

said panel having at least one pair of opposed side edges including coupling parts formed to cooperate with each other to couple similar panels along mutual side edges when brought together;

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said coupling parts comprising substantially a tongue, a groove and mechanical locking elements all formed in one piece with the core of the panel;

said locking elements arranged so that they prevent the drifting apart of coupled panels in a direction perpendicular to the mutual edges along which the panels are coupled and in a direction perpendicular to said mutual edges and parallel to a plane including coupled panels;

said mechanical locking elements comprising at least a first upper surface portion of said tongue extending toward said panel upper side, and a portion of an upper wall of said groove formed to cooperate in locking relationship in a direction perpendicular to the mutual edges along which the panels may be coupled with at least a portion of the first upper surface portion of said tongue when similar panels are coupled;

said locking elements formed at exposed side edges of the core material and being entirely located between said decorative and backing layers and not intersecting either of said decorative and backing layers.

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EXHIBIT F

(12) **United States Patent**
Moriau et al.

(10) **Patent No.:** **US 6,993,877 B2**
(45) **Date of Patent:** **Feb. 7, 2006**

(54) **FLOOR PANELS WITH EDGE CONNECTORS**

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Related U.S. Application Data

(63) Continuation of application No. 09/471,014, filed on Dec. 23, 1999, now Pat. No. 6,490,836, which is a continuation of application No. 08/872,044, filed on Jun. 10, 1997, now Pat. No. 6,006,486.

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(57) **ABSTRACT**

(51) **Int. Cl.**

E04B 2/32 (2006.01)

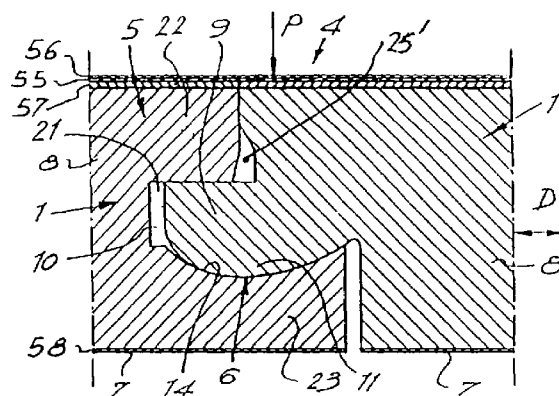
(52) **U.S. Cl.** **52/592.2**; 52/582.1; 52/586.1; 52/592.4; 52/480; 52/403.1

(58) **Field of Classification Search** 52/403.1, 52/480, 582.1, 587.1, 586.1, 588.1, 592.1, 52/592.4, 591.3, 590.2, 578, 177, 747.1, 52/747.11, 748.11; 403/364, 375, 381

See application file for complete search history.

Floor covering, including hard floor panels which, at least at the edges of two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges and parallel to the underside of the coupled floor panels, and provide a snap-action coupling.

15 Claims, 10 Drawing Sheets



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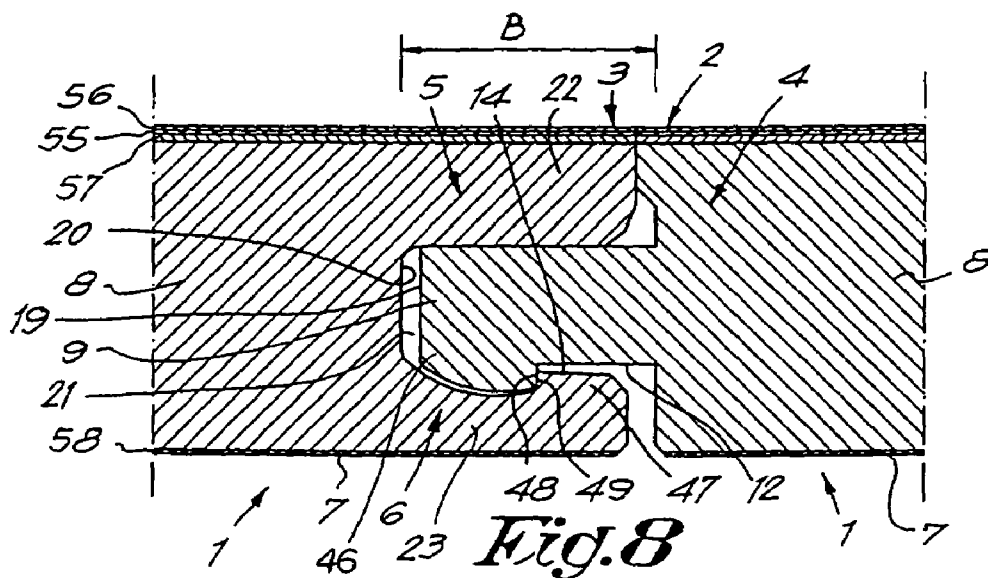
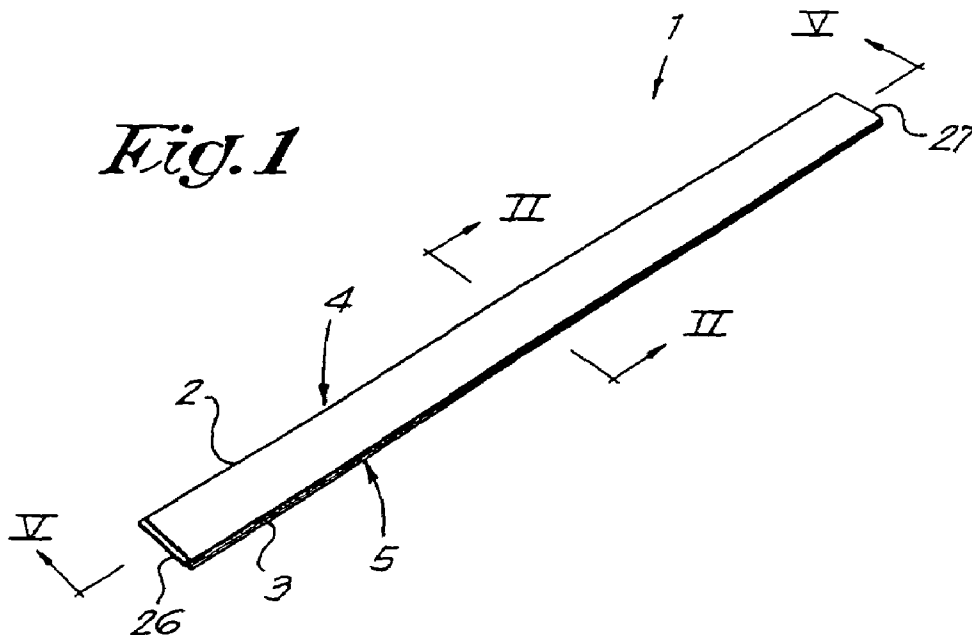
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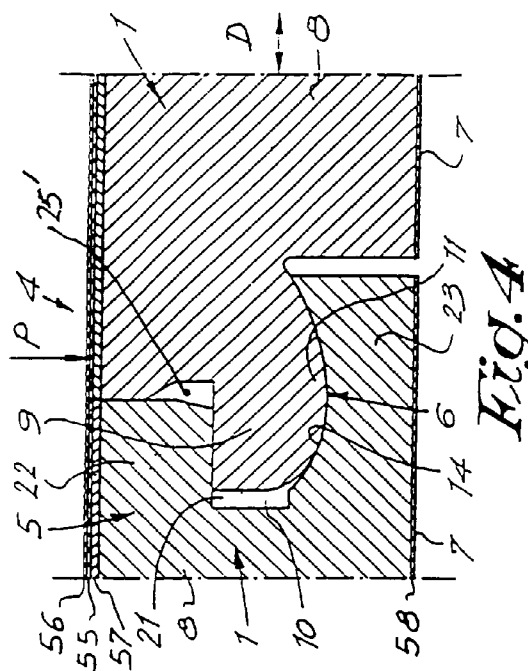
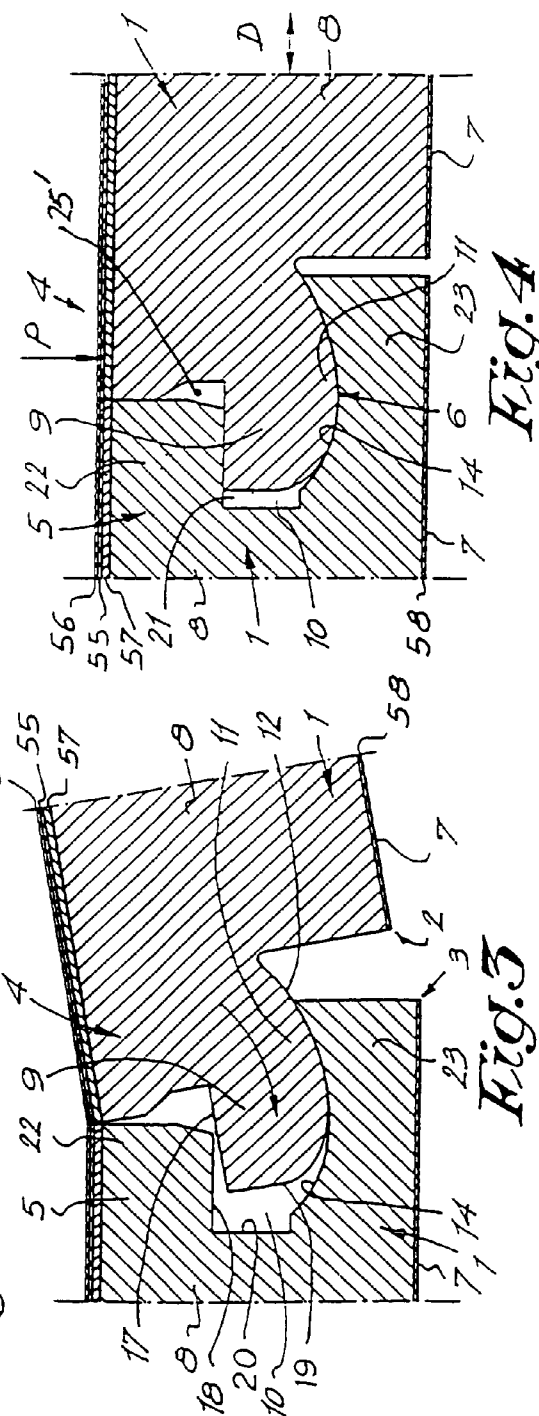
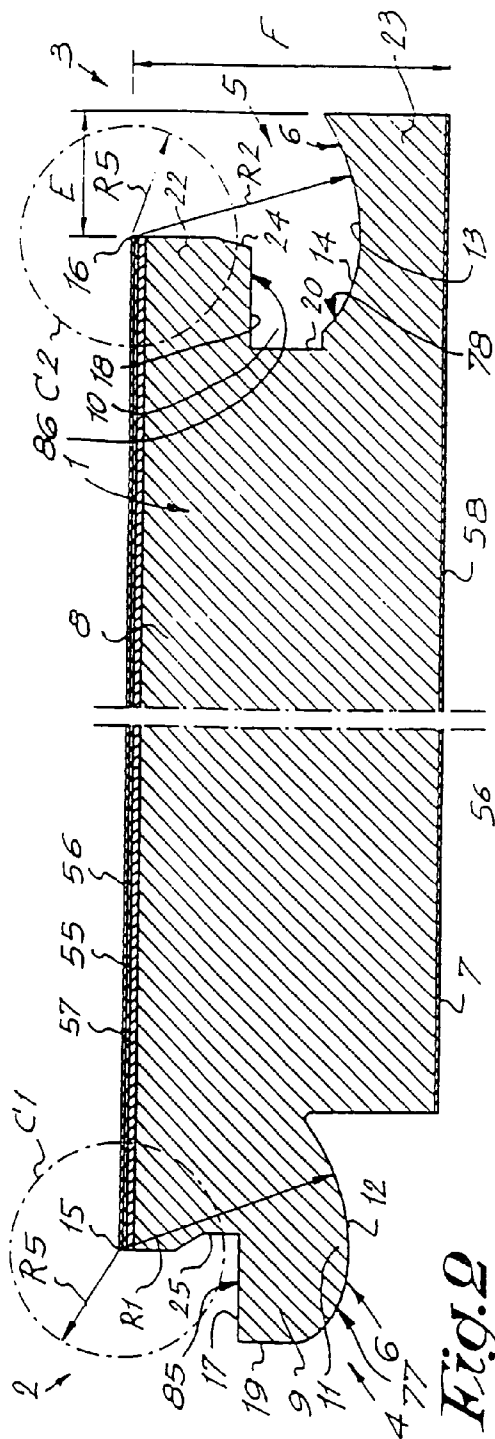
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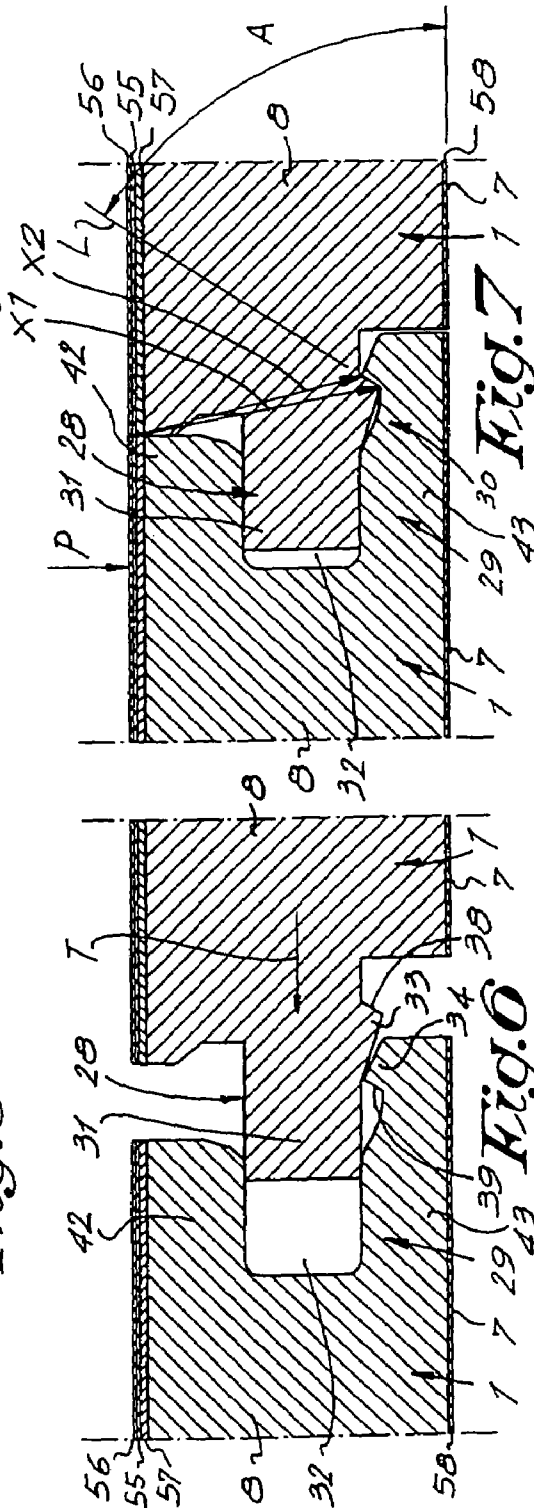
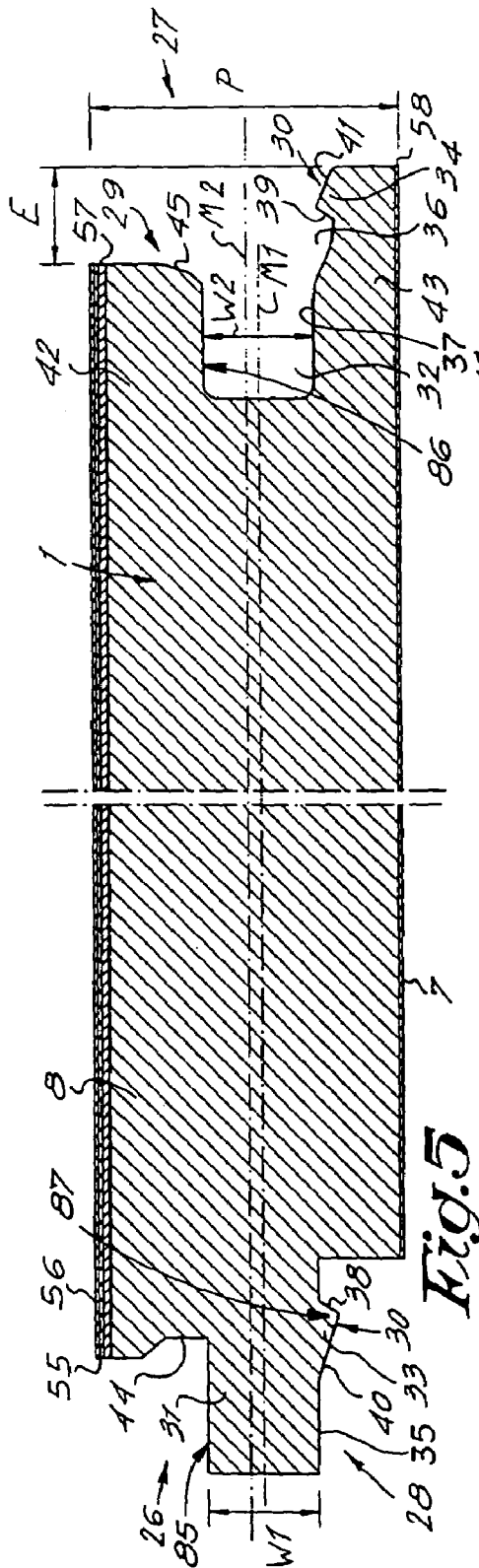
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Fig. 1







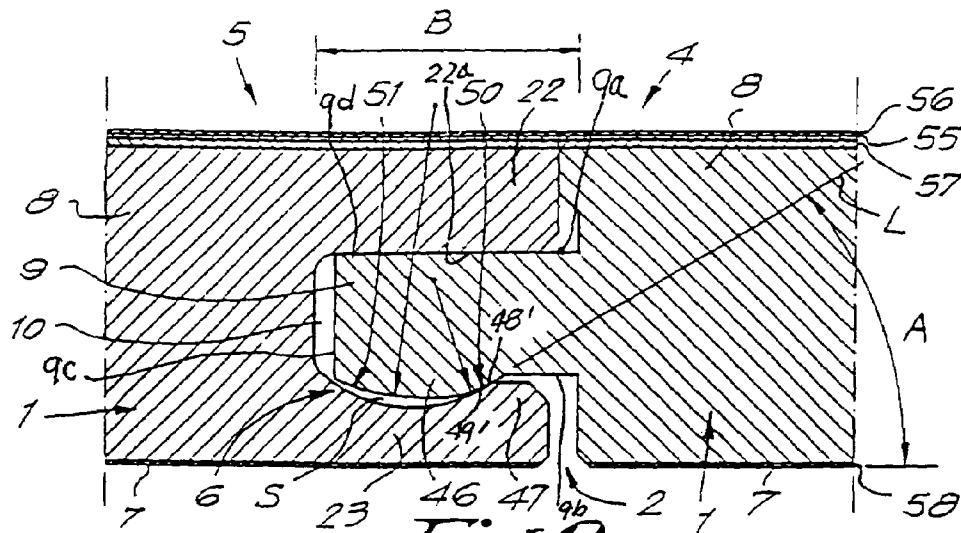


Fig. 9

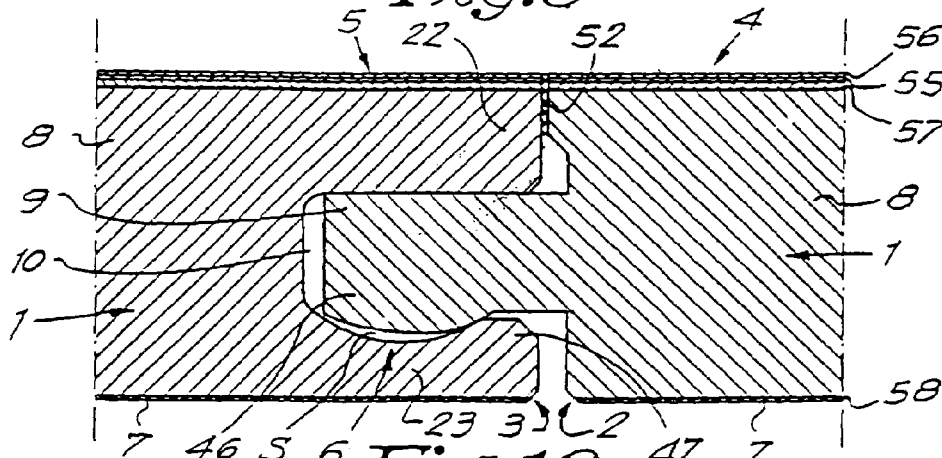


Fig. 10

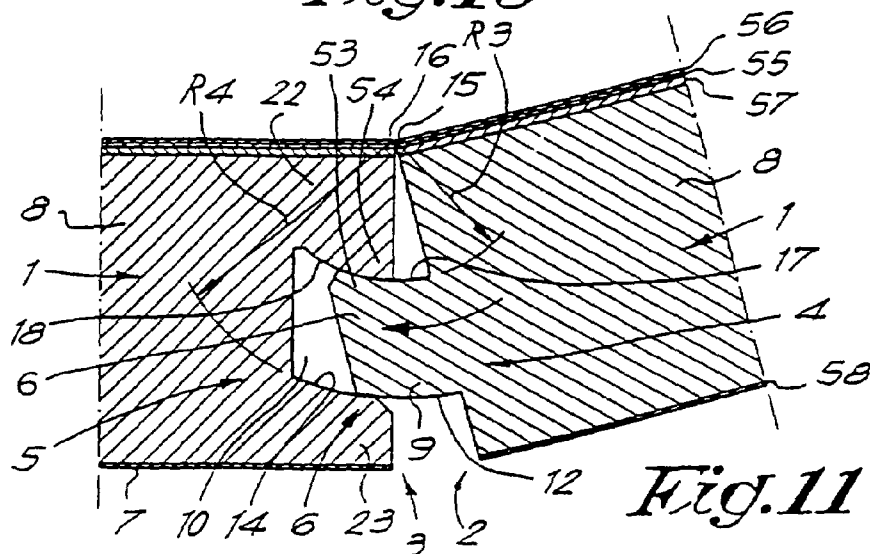


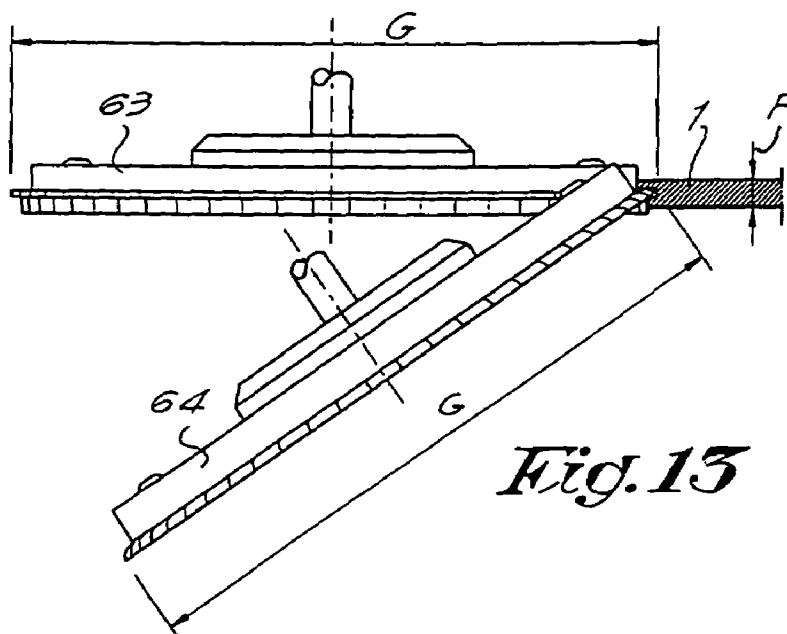
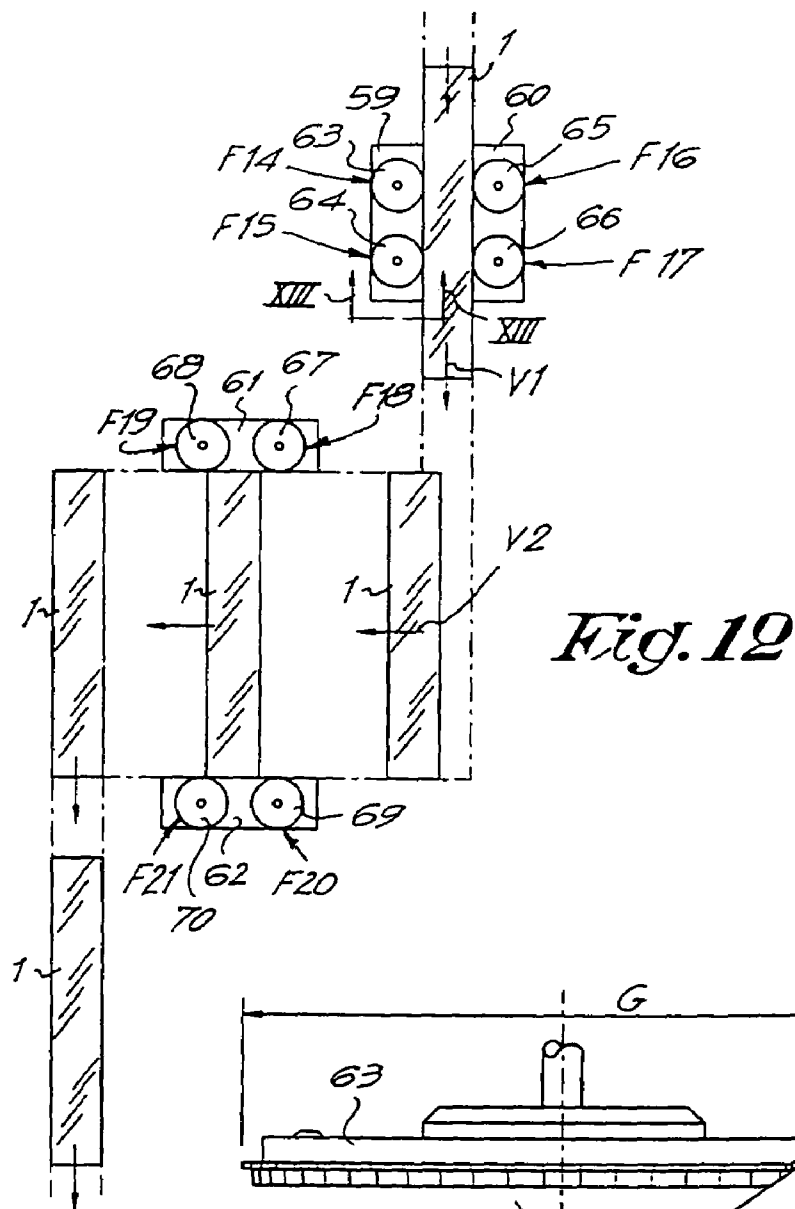
Fig. 11

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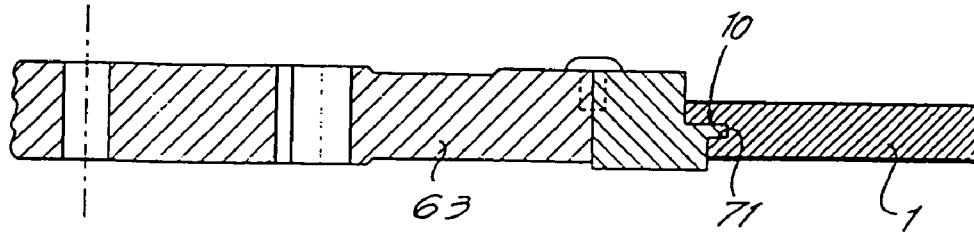


Fig. 14

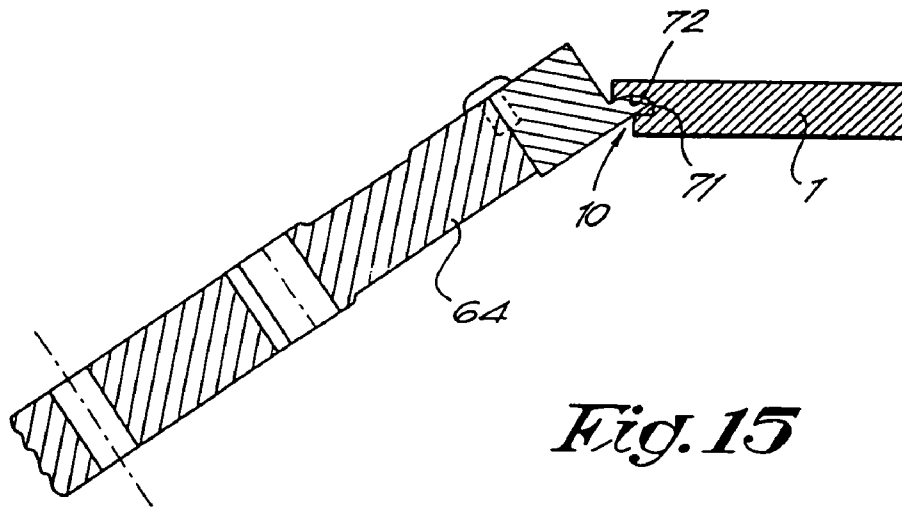


Fig. 15

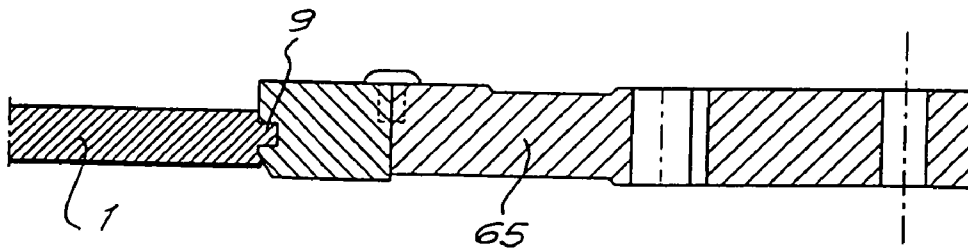


Fig. 16

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Fig. 17

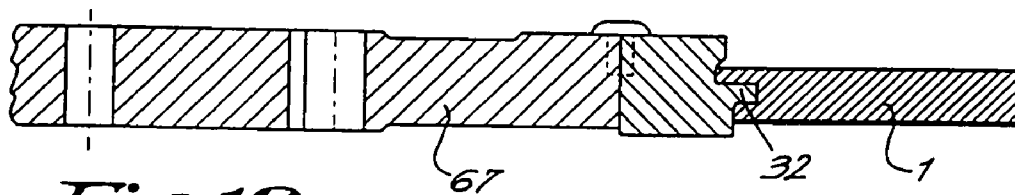
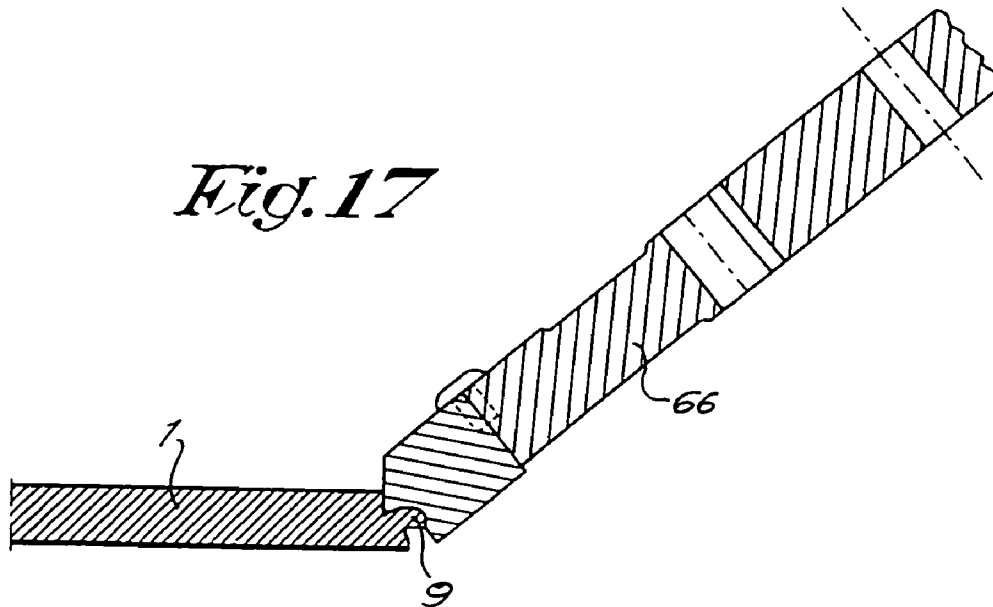


Fig. 18

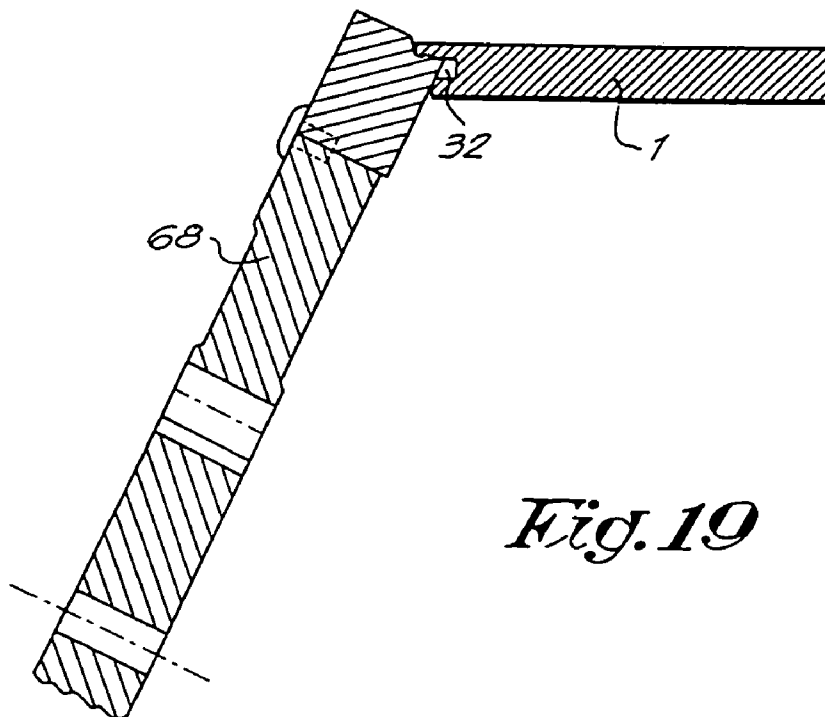


Fig. 19

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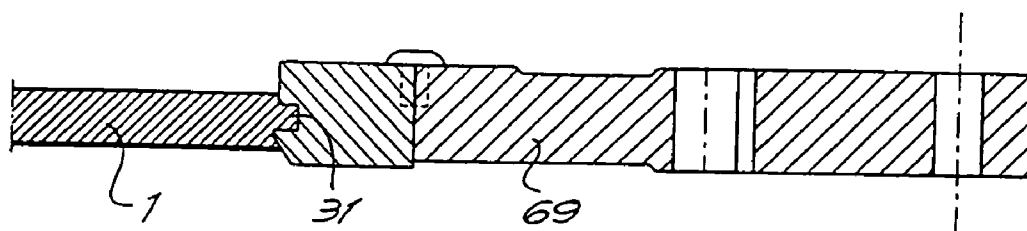


Fig. 20

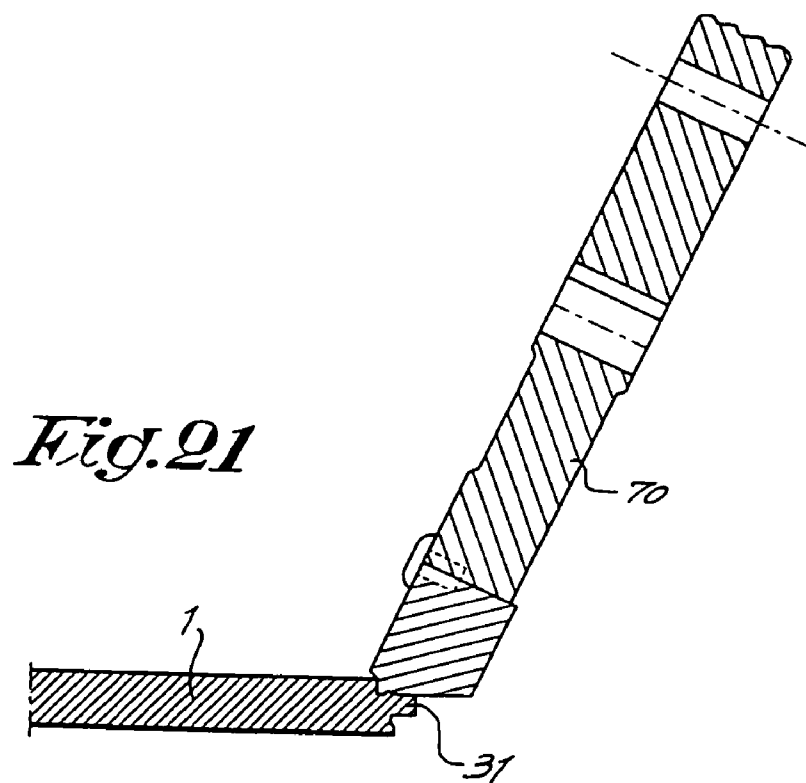
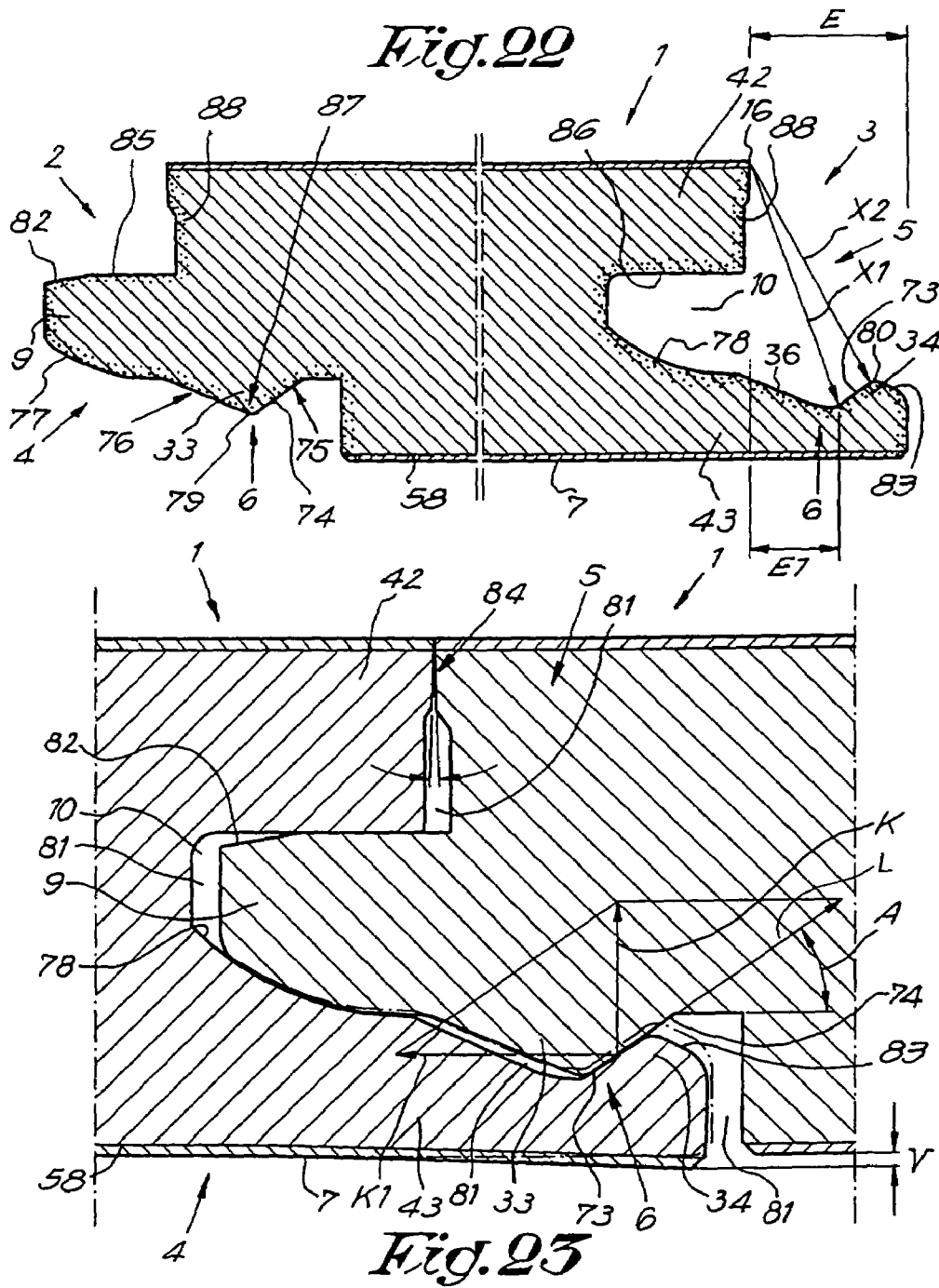


Fig. 21

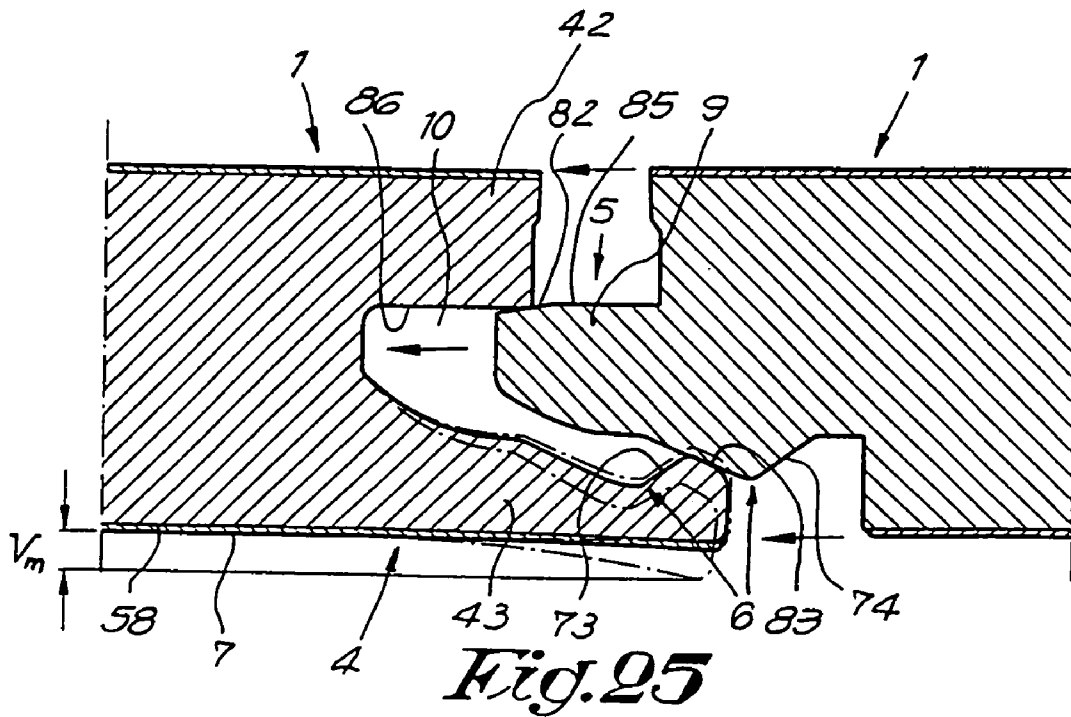
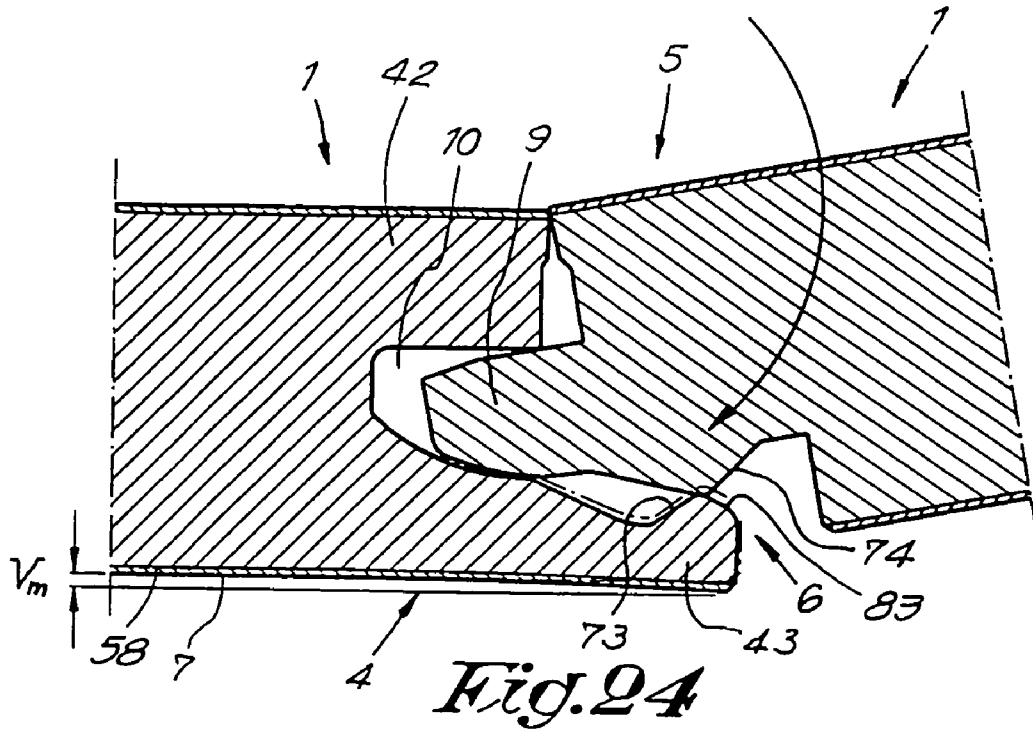


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FLOOR PANELS WITH EDGE CONNECTORS**RELATED APPLICATION DATA**

This application is a continuation of application Ser. No. 09/471,014, filed Dec. 23, 1999 now U.S. Pat. No. 6,490,836; which is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997, now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION**1. Field of the Invention**

This invention relates to floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

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Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are

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formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles (fibers) and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion

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and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. 1 represents a floor panel of a floor covering according to the invention;

FIG. 2, on a larger scale, represents a cross-section according to line II—II in FIG. 1;

FIGS. 3 and 4 represent how two floor panels with coupling parts according to FIG. 2 match into each other;

FIG. 5, on a larger scale, represents a cross-section according to line V—V in FIG. 1;

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FIGS. 6 and 7 represent how two floor panels with coupling parts according to FIG. 5 match into each other;

FIGS. 8 to 11 represent a number of variants of coupling parts of floor panels according to the invention;

FIG. 12 schematically represents how the floor parts can be provided with coupling parts;

FIG. 13 represents a cross-section according to line XIII—XIII in FIG. 12;

FIGS. 14 to 21, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. 12 with arrows F14 to F21;

FIG. 22 represents a floor panel according to the invention;

FIG. 23, on a larger scale, represents the coupling of two floor panels of FIG. 22;

FIGS. 24 and 25 represent two manners of coupling floor panels according to FIG. 22 to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels 1, for example, such as a laminated panel as shown in FIG. 1.

These floor panels 1 can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. 1, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is, at least at the edges of two opposite sides 2-3, provided with coupling parts 4-5 which permit two adjacent identical floor panels 1 to be coupled to each other.

According to the invention, the coupling parts 4-5, as represented in the FIGS. 2 to 4, are provided with integrated mechanical locking parts or locking elements 6 which prevent the drifting or sliding apart of two coupled floor panels 1 in a direction D perpendicular to the respective sides 2-3 and parallel to the underside 7 of the coupled floor panels 1; the coupling parts 4-5 and the locking elements 6 are formed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two subsequent floor panels 1 can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel 1 can be laterally inserted into the previous; and the coupling parts 4-5 preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels 1 with an elongated shape, as represented in FIG. 1, the respective coupling parts 4-5 are located at the longitudinal sides 2-3.

The coupling parts 4-5 can be realized in various forms, although the basic forms thereof will always be formed by a tongue 9 and a groove 10.

In the form of embodiment of FIGS. 2 to 4, the related floor panel 1 is provided with coupling parts 4-5 and locking means or locking elements 6 which allow two floor panels 1 to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements 6 consist of a first locking element 11, formed by a protrusion with a bent round (arcuate) shape at the lower side 12 of the tongue 9 (tongue arcuate lower surface), and a second locking element 13 (shown in FIG. 2), formed by a first recess with

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a bent hollow or downwardly concave shape in the lower wall 14 of the groove 10 (groove arcuate lower surface portion).

The locking elements 11-13 ensure that two floor panels 1 which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels 1 to be inserted into each other by means of a turning movement, the curvatures preferably are circular segment shaped. The bottom side 12 of locking means or locking elements 6 has a curvature with a radius R1, the center of which coincides with the respective upper edge 15 of the floor panel 1, whereas the lower wall 14 of the locking part 5 has a curvature with a radius R2 which is equal to the radius R1, but its center coincides with the respective upper edge 16. Radii R1 and R2 may also be applied which are larger or smaller than the distance to the upper edge 15, 16 respectively, and/or which differ from each other in size.

The upper side or surface 17 of the tongue 9 (tongue planar upper surface portion) and the upper surface or side 18 of the groove 10 (groove planar upper surface portion) are preferably planar and preferably are located in the horizontal plane.

The inner side 20 of the groove 10 and the front side or distal end 19 of the tongue 9 of the two interlocked floor panels 1 preferably do not fit closely against each other, such that an intermediate space 21 is created between them into which possible dust remainders or such can be pushed away by means of the tongue 9.

The tongue 9 and the groove 10 preferably have shapes which are complementary to each other, such that the tongue planar upper surface portion of tongue 9 in the engaged condition of two identical floor panels 1 precisely sits against the groove planar upper surface portion of upper wall 18 and the arcuate lower surface portion 14 of the groove 10 engages the tongue arcuate lower surface portion of tongue 9, whereby a pressure P, exerted against the first upper edge contact surface at the end of upper lip 22 by the second upper edge contact surface above the tongue 9, is received or reacted not only by this lip 22, but by the complete structure, because this pressure can be transmitted through the tongue 9 and the lower lip 23 to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer 24 on lip 22 and a second recess 25 can be provided, as represented in FIGS. 2 to 4, as a result of which the subsequent floor panels 1 can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. 5 to 7, the floor panels 1 according to the invention can also, along the sides 26-27 which are at a right angle to the sides 2-3, be provided with coupling parts 28-29 which have locking elements 30, too. The coupling parts 28-29 are preferably also realized in the shape of a tongue 31 and a groove 32. Hereby, the locking elements 30 do not have to be of the same nature as the locking elements 6.

Preferably, at the sides 26-27 locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. 6 and 7. To this aim, the locking elements 30 consist of a snap-together connection with locking elements 33 and 34 which grip behind each other.

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As represented in FIGS. 5 to 7, the locking element 33 preferably consists of a protrusion of the lower side 35 of the tongue 31 which can be located in a recess 36 in a lower lip 43 extending distally from the lower wall 37 of the groove 32. The locking element 34 is formed by the upward directed part or protrusion which defines the distally outer end of recess 36.

In this case, the locking elements 33-34 have contact surfaces 38-39 which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces 38-39, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside 7, which angle is smaller than 90°.

The locking elements 33-34 preferably are provided with inclined portions 40 and 41 which, when two floor panels 1 are engaged, cooperate with each other in such a manner that the locking elements 33-34 can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. 6 and 7).

The thickness W1 of the tongue 31 preferably is equal to the width W2 of the groove 32, such that compression pressure P applied to the upper lip 42 is reacted by the tongue 31 which, in its turn, then is reacted by the lower lip 43.

Analogous to the chamfer 24 and recess 25, a recess or clearance 44 and a chamfer 45 are provided also at the edges 28-29 above a tongue planar upper surface as shown when panels are coupled along cooperating edges 28-29 the recess 44 defines a chamber 25' as shown in FIG. 4. Panel edges contact each other above the recess 44, as shown at upper edge contact surfaces.

It is noted that such a snap-together coupling can also be applied at the edges 2-3. Hereby, this can be a snap-together coupling analogous to these of FIGS. 5 to 7, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. 8 and 9. Contrary to the locking elements 33-34 which consist of rather local protrusions, in the forms of embodiment of FIGS. 8 and 9 use is made of locking elements 46-47 which, in comparison to the total width B of the coupling, extend over a rather large distance.

In this case, the locking elements 46-47 are also provided at the lower side 12 of the tongue 9 and the lower wall 14 of the groove 10.

According to FIG. 8, the locking elements 46-47 have contact surfaces 48-49 which are at an angle with the plane of the floor panel 1. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. 9, the locking elements 46-47 possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements 46-47 hereby consist of curved surfaces. The common plane of tangency L forms an angle A which is smaller than 90°, and more preferably is smaller than 70°.

In this manner, the locking element 46 preferably has two portions with a different curvature, on one hand, a portion 50 with a strong curvature and, on the other hand, a portion 51 with a weak curvature. The portion 50 with the strong curvature provides for the formation of a firm coupling. The portion 51 with the weak curvature facilitates the coupling parts 4-5 to be brought into each other easily. The collective

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surfaces 50 and 51 may be referred to as the tongue arcuate lower surface portion, in the same manner as the tongue arcuate lower surface portion in FIGS. 2 to 4 described above. The tongue 9 in FIGS. 9 and 10 include tongue planar upper surface portions and the groove 10 includes a groove planar upper surface portion and a groove arcuate lower surface portion similar to the example shown in FIGS. 2 to 4. The intermediate space S forms a chamber which offers space for dust and the like which, when engaging two floor panels 1, inevitably infiltrates there. The chamber at intermediate space 5, the chamber 25' defined by recess 44, and clearance 21 are or may be essentially independent clearances or chambers when the tongue and groove elements are coupled, as illustrated. It will be noted that the tongue 9 in FIGS. 9 and 10 has a cross-sectional periphery that defines the outer shape of the tongue in transverse cross-section. As illustrated, the tongue 9 includes an upper surface 9a, a lower surface 9b and a distalmost surface 9c, the outer form or profile of the tongue along and connecting these surfaces constituting a tongue periphery that includes an upper tongue contact surface 9d that engages an upper groove or lip contact surface 22a when panels are coupled as seen in FIG. 9 and the lower contact surface 48' engaging the lower groove or lip contact surface 49' intersecting the common plane of tangency L in this example.

As seen in FIGS. 5, 6 and 7, an intermediate lower tongue contact surface 31a engages intermediate lower groove, or lip contact surface 32a when the tongue 31 and groove 32 are coupled together. The intermediate contact surfaces are located along the periphery of tongue 31 and the surface of groove 32 between lower contact surfaces 38, 39 and upper contact surfaces 85, 86 between the tongue and groove elements.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. 7 to 9, preferably the tongue 9-31 has a shape that thickens from below, which then can cooperate with a widened portion in the groove 10.

In FIG. 10, a variant is represented whereby at least at the level of the upper contact edges 15-16, a sealing material 52 is provided, as a result of which a watertight sealing can be assured. This sealing material 52 may consist of a strip or covering which is provided previously at the floor panel 1, either at one or both upperside edges 15-16.

In FIG. 11, a further variant is represented, whereby the locking element 6 is formed by an upward directed portion 53 at the tongue 9, which as a result of a turning movement of the panel, is brought behind a downward-directed portion 54 on the upper wall 18. More particularly, this is obtained by forming the upper side 17 and the upper wall 18 with a curvature R3, the center of which is situated at the upperside edges 15-16, and forming the lower side 12 and the lower wall 14 with a radius R4, the center of which is also situated at the upperside edges 15 and 16, respectively. These radii R3-R4 can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius R1, R3 respectively, and, on the other hand, the radius R2, R4 respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle C1, C2 (see FIG. 2) respectively, which extends with a radius R5 of 3 mm centered at upperside edge 15, 16 respectively.

Finally is noted that, according to the invention, the lower lip 23-43, as represented in FIGS. 2 to 7, can be formed distally longer than the upper lip 22-42. This has an advantage that the coupling parts 4-5-28-29 can be shaped in an easier manner by means of a milling cutter or the like.

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Furthermore, this simplifies the engagement of two floor panels **1**, because each subsequent floor panel **1** during installation can be placed upon the protruding lower lip **23-43**, as a result of which the tongue **9-31** and the groove **10-32** automatically are positioned in front of each other. On the other hand, in accordance with FIGS. **9-11**, the upper and lower lips **22, 23** can be substantially the same length so as to terminate in a common vertical plane.

The embodiments wherein the lower lip **23** is equal to or distally shorter than the upper lip **22**, in their turn, offer the advantage that no protruding lip **23** remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference E between the distally outer edge of the upper lip **22-42** and the distally outer edge of the lower lip **23-43**, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove **10**, should preferably be kept smaller than one time the total thickness F of the floor panel **1**. For stability's sake, normally this total thickness F shall never be less than 5 mm.

The small dimension of the difference E offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line M1 through the tongue **9** and the groove **10** is situated lower than the center line M2 of the floor panel **1**, such, that the upper lip **22-42** is thicker than the lower lip **23-43**. In first instance, this is essential in this kind of connection, because then it is the lower lip **23-43** which bends, whereby the upper side of the floor panel **1** is kept free of possible deformations.

As explained in the introduction, for the core **8** a material is chosen from the following series:

- a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;
- a product based on synthetic material;
- chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. **2 to 11**, such laminated flooring preferably consists of a core **8** made of MDF medium density fiberboard board, HDF high density fiberboard board or similar, whereby at least at the upper side of this core **8** one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer **55** and a protective top layer **56**. The decorative layer **55** is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer **56** preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer **57** upon which the decorative layer **55** is provided.

Preferably, also a backing layer **58** shall be applied at the underside **7**, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the

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floor panel **1**. This backing layer **58** may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. **12**, the tongue **9** and the groove **10**, and preferably also the tongue **31** and the groove **32** are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels **1** preferably shall be displaced by means of two sequential perpendicular movements V1 and V2, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices **59-60**, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices **61-62**. During these processing, the floor panels **1** preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue **9-31** and groove **10-32** are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel **1**.

This is illustrated in FIGS. **13, 14** and **15**, wherein it is represented how a groove **10** is realized by means of two milling cycles by means of two milling cutters **63** and **64**. FIGS. **16** and **17** represent how the tongue **9** is shaped by means of milling cutters **65** and **66**.

The FIGS. **18-19** and **20-21** represent similar views showing how the groove **32** and the tongue **31** are shaped by means of milling cutters **67-68** and **69-70**, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter **63** of FIG. **14** determines the final shape of the lower flank **71** of the groove **10**, whereas the milling cutter **64** determines the final shape of the upper flank **72**.

As mentioned in the introduction, preferably milling cutters **63 to 72** shall be used, having diameters G which are at least 5 times, and even better at least 20 times larger than the thickness F of the floor panels **1**.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. **22 to 25**, a particularly preferred form of embodiment of a floor panel **1** according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

An important characteristic herein consists in that the coupling parts **4-5** are provided with locking elements **6** which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels **1** are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip **43**, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels **1** being forced towards each other. The resultant bending V, as well as the tension force K, are indicated in the enlargement view of FIG. **23**.

In order to obtain the tension force K pressing together the engaged floor panels **1**, the bendable portion, in this case the lip **43**, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface **73** which

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preferably can cooperate with a corresponding contact surface **74** on tongue **9**. These contact surfaces **73–74** are similar to the aforementioned contact surfaces **39–38** and also similar to the inclined portions of the lower lip of FIGS. **2** to **4**.

In the FIGS. **2** and **5**, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. **23** can be realized.

Due to, on one hand, the contact along the angle **A**, and, on the other hand, the fact that a tension force **K** is created, a compression force component **K1** is produced, as a result of which the floor panels **1** are drawn against each other in compression.

Preferably, the angle **A** of the mutual plane of tangency of contact surfaces **73–4** relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force **K** is realized, an angle **A** of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels **1** and, on the other hand, to ensure that the floor panels **1** can easily be engaged and respectively disassembled.

Although the pressing or compression force component **K1** preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending **V** is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending **V** of the lip **43** only produces local bending of the underlayer.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4–5**, including the locking elements **33–34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core **8**, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. **22** to **25** consists in that the floor panels **1** can be selectively engaged by means of a turning movement, as represented in FIG. **24**, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. **25**, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending **Vm** results in the coupling parts, more particularly

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in the lip **43**, which bending **Vm** is less pronounced, if not nonexistent, as in the FIGS. **2** to **4**, in comparison to the bending **Vm** which results when the floor panels **1** are engaged by means of shifting them towards each other, as in FIG. **15**.

The advantage of this consists in that the floor panels **1** can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel **1** can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts **4–5** shown in FIGS. **22** to **25** can also be used for the coupling parts **28–29** of the short sides of the panels.

According to the invention, in the case that the four sides **2–3–26–27** are provided with coupling parts **45–28–29**, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels **1**, for example, such as represented in FIG. **1**, the locking at the small sides **26–27** preferably shall be more pronounced than at the longitudinal sides **2–3**. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces **73–74** with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element **33**, is bounded by at least two portions **75–76** (shown in FIG. **22**), respectively a portion **75** with a strong (steep) inclination which provides for the locking, and a portion **76** with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. **22** to **25**, these portions **75–76** are formed by straight planes, but, as already described with reference to FIG. **9**, use can also be made of curved portions **50–51**. In FIG. **5**, these are the contact surface **38** and the inclined portion **40**.

In the preferred form of the invention, the floor panels **1** comprise coupling parts **4–5** and/or **28–29** exhibiting one of the following or the combination of two or more of the following features:

- a curvature **77** (shown in FIG. **22**) at the lower side of the tongue **9** and/or a curvature **78** at the lower lip **43** which form a guidance when turning two floor panels **1** into each other, with the advantage that the floor panels **1** can be engaged into each other easily during installation;

- roundings **79–80** at the edges of the locking elements **33–34**, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels **1** and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;

- dust chambers **81**, or spaces **21** as in FIG. **4**, between all sides, directed laterally towards each other, of the engaged floor panels **1**, with the advantage that inclusions which get between the floor panels **1** during the engagement do not exert an adverse influence upon good engagement;

- a shaping of the tongue **9** which is such, for example, by the presence of a chamfer **82**, that the upper side of the

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tongue 9 becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip 42 when the floor panels 1 are pushed towards each other in substantially the same plane, as indicated in FIG. 25, with the advantage that the front extremity or end of the tongue 9 does not press against the front side of the upper lip 42 or the front edge of the bottom lip 43 when the floor panels are pushed towards each other in the same plane;

a ramp surface 83, hereinbefore also called inclined portion 41, formed at the distally outer end of the lower lip 43, with the advantage that the locking elements 33-34 shift smoothly over each other and that the lower lip 43 is bent uniformly;

in the engagement direction only one important contact point which is formed by a section 84 at the location of the upperside edges of the floor panels 1, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels 1 and that the development of openings between the floor panels 1 is counteracted;

contact surfaces 85-86, more particularly abutment surfaces, formed by the upper side of the tongue 9 and the upper side of the groove 10 which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels 1, as well as contact surfaces cooperating with each other, formed by curvatures 77-78, with the advantage that no mutual displacement in height between two engaged floor panels 1 is possible, even if the insertion depth of the tongue 9 into the groove 10 should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. 22 to 25, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. 2 to 11, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. 5 to 7 and 22 to 25, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element 6, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip 23-43 which extends beyond the distal edge of the upper lip 22-42, more particularly, the lowermost point 87 of the locking part 33 is situated under the top layer of the floor panel 1. For clarity's sake, this top layer is indicated in the FIGS. 22-25 only as a single layer.

It should be noted that the combination of features, the lower lip 23-43 extending further than the upper lip 22-42; the locking elements 6 being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip 23-43 which extends distally beyond the upper lip 22-42, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels 1 can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip 23-43 adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface 39 or 73, preferably extends in such a manner that the distance between the upper edge 16 of the panel to the contact surface

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39, 73 diminishes between the proximal and distal ends of the sloping contact surface 39, 73, in other words, such that, as represented in FIG. 22, the distance X2 is smaller than the distance X1. This is also the case in FIG. 7.

Still preferably, this portion only starts at a clear distance E1 from the outer edge of upper lip 42.

It is obvious that the coupling parts 22 to 25 can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels 1 are treated at their sides 2-3 and/or 26-27 with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. 22, such impregnation 88 is represented schematically. This treatment can be performed over the complete surface of the sides 2-3 and/or 26-27 or only over specific portions hereof, for example exclusively on the surfaces of the tongue 9 and the groove 10.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts 4-5 and/or 28-29 better keep their shape and strength, even if the floor panels 1 are engaged and disassembled repeatedly. In particular, if the core 8 is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels 1 can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

What is claimed is:

1. Floor covering panel comprising a hard floor panel having opposed long and short side edges to define a rectangular shape, said panel comprising a laminated construction including a core portion, and upper and lower surface layers, and at least one opposed pair of said side edges each provided with a coupling part;

each coupling part configured to cooperate with a cooperating coupling part of another one of said panel to enable coupling of the panels along contiguous side edges;

said coupling parts comprising substantially a tongue, a groove and mechanical locking elements all formed in one piece with the core portion of the panel;

said core portion being formed of MDF/HDF;

said locking elements cooperating when coupled to prevent the drifting apart of two coupled ones of said panel in a direction perpendicular to the plane of the coupled panels, and in a direction perpendicular to the contiguous edges along which the panels are coupled and parallel to undersides of the coupled panels;

said tongue of one of said coupling parts defining one locking element as at least one protrusion having an

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arcuate shape on the lower side of the tongue and a cooperating other locking element associated with a groove of said coupling parts located on a side edge of the panel opposite the edge on which the tongue is located;

a lower lip extending from a lower wall of said groove and an upper lip of said groove defined at least partly by an upper wall of the groove, said upper lip terminating at an upper lip wall and said lower lip extending distally beyond the upper lip wall;

said other locking element comprising a first recess in an upper surface of the lower lip, said first recess located at least partly distally beyond said upper lip wall;

a chamfer on the upper lip wall adjacent the intersection of the upper lip wall with the upper wall of the groove, said chamfer sloping inwardly towards the interior of the groove;

said upper wall of said groove comprising a substantially planar groove upper wall surface portion located between said upper lip wall and an inner side of the groove;

said tongue including a substantially planar tongue upper surface portion;

said coupling parts configured such that said groove upper wall surface portion and said tongue upper surface portion engage and cooperate with each other when similar ones of the panel are coupled.

2. The floor covering panel according to claim 1, wherein said first recess comprising said other locking element is arcuate and possesses a curvature substantially complementary to the curvature of the at least one protrusion.

3. The floor covering panel according to claim 2, wherein the protrusion and first recess extend along circular curved segments.

4. The floor covering panel according to claim 1, wherein said substantially planar groove upper wall surface portion and said tongue upper surface portion extend substantially parallel with the underside of said panel.

5. The floor covering panel according to claim 1, including a second recess adjacent the inner end of the tongue upper surface portion in the panel side edge including said tongue; said chamfer and second recess defining a clearance between coupled ones of the panel below the upper surface layer and above the tongue of the coupling parts upon coupling of similar panels.

6. The floor covering according to claim 1, wherein said coupling parts are configured such that coupling between similar ones of said panel is enabled by rotating one panel relative to another panel about their adjacent side edges having respectively a tongue and a groove, whereby upon coupling said protrusion engages said first recess in cooperating relationship.

7. The floor covering according to claim 1, wherein said tongue terminates at a distal end, and said groove and tongue are configured such that upon coupling of cooperating coupling parts of similar ones of said panel, a clearance is provided between the distal end of the tongue of one coupling part and the inner side of the groove of the other coupling part.

8. The floor covering panel according to claim 7, wherein similar coupling parts configured to cooperate with a cooperating coupling part of another one of said panel are provided at both said opposed side edges.

9. A floor covering panel comprising a substantially rectangular, inclusive of rectangular and square shapes, interlocking hard floor panel, said hard floor panel having an

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upper side, an underside and a perimeter defining first and second pairs of opposed substantially parallel edges;

said panel having a thickness of 0.5 to 1.5 cm. and comprising a laminated construction including a core portion made of MDF/HDF;

said first pair of edges being provided with cooperating coupling parts substantially in the form of a tongue and a groove extending substantially along the length of the first pair of edges, said tongue and groove formed entirely of said core portion;

the tongue defining locking elements in the form of a tongue planar upper surface portion and a tongue arcuate lower surface portion that is convex relative to the underside of the floor panel;

said groove defining locking elements in the form of a groove upper wall planar surface portion and a groove arcuate lower wall surface portion that is concave relative to the underside of the floor panel;

said coupling parts configured to be coupled by rotating similar ones of said panel relative to each other about adjacent panel edges to couple the panels against movement relative to each other in a directions perpendicular to the adjacent edges of the coupled panels when the coupling parts are coupled with said tongue planar upper surface portion and said groove planar upper surface portion in engagement with each other;

wherein the groove includes a lower lip and an upper lip, said lower lip extending distally beyond the upper lip; wherein the groove arcuate lower wall surface portion is located partly distally beyond the upper lip;

wherein said tongue terminates at a distal end, said groove terminates at its inner end at a groove inner side, and said groove and tongue are configured such that upon coupling of cooperating coupling parts of similar ones of said panel, a clearance is provided between the distal end of the tongue of one coupling part and the groove inner side of the other coupling part.

10. A floor covering panel comprising a substantially rectangular, inclusive of rectangular and square shares, interlocking hard floor panel, said hard floor panel having an upper side, an underside and a perimeter defining first and second pairs of opposed substantially parallel edges;

said panel having a thickness of 0.5 to 1.5 cm. and comprising a laminated construction including a core portion made of MDF/HDF;

said first pair of edges being provided with cooperating coupling parts substantially in the form of a tongue and a groove extending substantially along the length of the first pair of edges, said tongue and groove formed entirely of said core portion;

the tongue defining locking elements in the form of a tongue planar upper surface portion and a tongue arcuate lower surface portion that is convex relative to the underside of the floor panel;

said groove defining locking elements in the form of a groove upper wall planar surface portion and a groove arcuate lower wall surface portion that is concave relative to the underside of the floor panel;

said coupling parts configured to be coupled by rotating similar ones of said panel relative to each other about adjacent panel edges to couple the panels against movement relative to each other in a directions perpendicular to the adjacent edges of the coupled panels when the coupling parts are coupled with said tongue planar upper surface portion and said groove planar upper surface portion in engagement with each other;

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wherein the groove includes a lower lip and an upper lip,
 said lower lip extending distally beyond the upper lip;
 wherein the groove arcuate lower wall surface portion is
 located partly distally beyond the upper lip;
 wherein said tongue planar upper surface portion includes 5
 an upper contact surface and said tongue arcuate lower
 surface portion includes a lower contact surface;
 a peripheral portion of said tongue extending along the
 tongue outer surface and between said contact surfaces
 defining an outer peripheral portion of said tongue; 10
 said groove including corresponding upper and lower
 groove contact surfaces on said groove planar upper
 surface portion and the groove arcuate lower surface
 portions that are respectively in contact with the upper
 and lower contact surface portions of said tongue when 15
 said coupling parts are coupled;
 said coupling parts when coupled defining at least one
 chamber therebetween along an area adjacent said outer
 peripheral portion of said tongue.

11. A floor covering panel comprising a substantially 20
 rectangular, inclusive of rectangular and square shapes,
 interlocking hard floor panel, said hard floor panel having an
 upper side, an underside and a perimeter defining first and
 second pairs of opposed substantially parallel edges,
 said panel having a thickness of 0.5 to 1.5 cm. and 25
 comprising a laminated construction including a core
 portion made of MDF/HDF;
 said first pair of edges being provided with cooperating
 coupling parts substantially in the form of a tongue and
 a groove extending substantially along the length of the 30
 first pair of edges, said tongue and groove formed
 entirely of said core portion;
 the tongue defining locking elements in the form of a
 tongue planar upper surface portion and a tongue
 arcuate lower surface portion that is convex relative to 35
 the underside of the floor panel;
 said groove defining locking elements in the form of a
 groove upper wall planar surface portion and a groove

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arcuate lower wall surface portion that is concave
 relative to the underside of the floor panel;
 said coupling parts configured to be coupled by rotating
 similar ones of said panel relative to each other about
 adjacent panel edges to couple the panels against
 movement relative to each other in a directions per-
 pendicular to the adjacent edges of the coupled panels
 when the coupling parts are coupled with said tongue
 planar upper surface portion and said groove planar
 upper surface portion in engagement with each other;
 wherein the groove includes a lower lip and an upper lip,
 said lower lip extending distally beyond the upper lip;
 wherein the groove arcuate lower wall surface portion is
 located partly distally beyond the upper lip;
 wherein a portion of the panel edge adjacent said tongue
 planar upper surface portion defines at least a portion of
 a clearance upon coupling of similar ones of the panel.

12. The floor covering panel according to claim **11**,
 wherein said clearance is defined between said upper side of
 coupled similar panels and said tongue planar upper surface
 portion.

13. The floor covering panel according to claim **12**,
 wherein when adjacent panels are coupled along at least one
 of said opposed parallel sides, and said clearance defines an
 enclosed volume in cross-section below said upper sides of
 said adjacent panels.

14. The floor covering panel according to claim **11**,
 wherein said portion of said panel edge adjacent said tongue
 planar upper side portion further defines a first upper edge
 contact surface located above said clearance.

15. The floor covering panel according to claim **14**,
 wherein a portion of said panel edge including said groove
 above said planar upper groove wall portion defines a
 second upper edge contact surface cooperating with said first
 upper edge contact surface located above said clearance.

* * * * *

EXHIBIT G

(12) **United States Patent**
Moriau et al.

(10) **Patent No.:** **US 7,040,068 B2**
(45) **Date of Patent:** **May 9, 2006**

(54) **FLOOR PANELS WITH EDGE CONNECTORS**

(75) Inventors: **Stefan Simon Gustaaf Moriau**, Gent (BE); **Mark Gaston Maurits Cappelle**, Staden (BE); **Bernard Paul Joseph Thiers**, Oostrozebeke (BE)

(73) Assignee: **Unilin Beheer B.V., besloten vennootschap**, IJssel (NL)

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(21) Appl. No.: **10/256,183**

(22) Filed: **Sep. 27, 2002**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

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E04B 2/46 (2006.01)

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52/592.2

(58) **Field of Classification Search** 52/403.1,
52/480, 588.1, 582.1, 586.1, 592.1, 592.4,
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See application file for complete search history.

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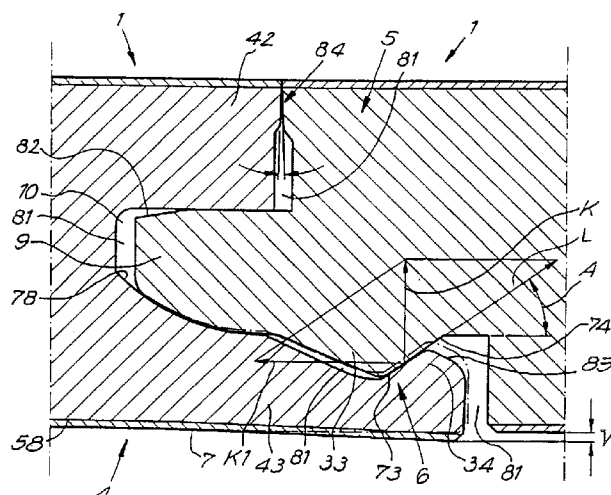
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(74) *Attorney, Agent, or Firm*—Bacon & Thomas PLLC

(57) **ABSTRACT**

Floor covering, including hard floor panels which, at least at the edges of two opposite sides, are provided with coupling parts, cooperating which each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges and parallel to the underside of the coupled floor panels, and provide a snap-action coupling.

57 Claims, 10 Drawing Sheets



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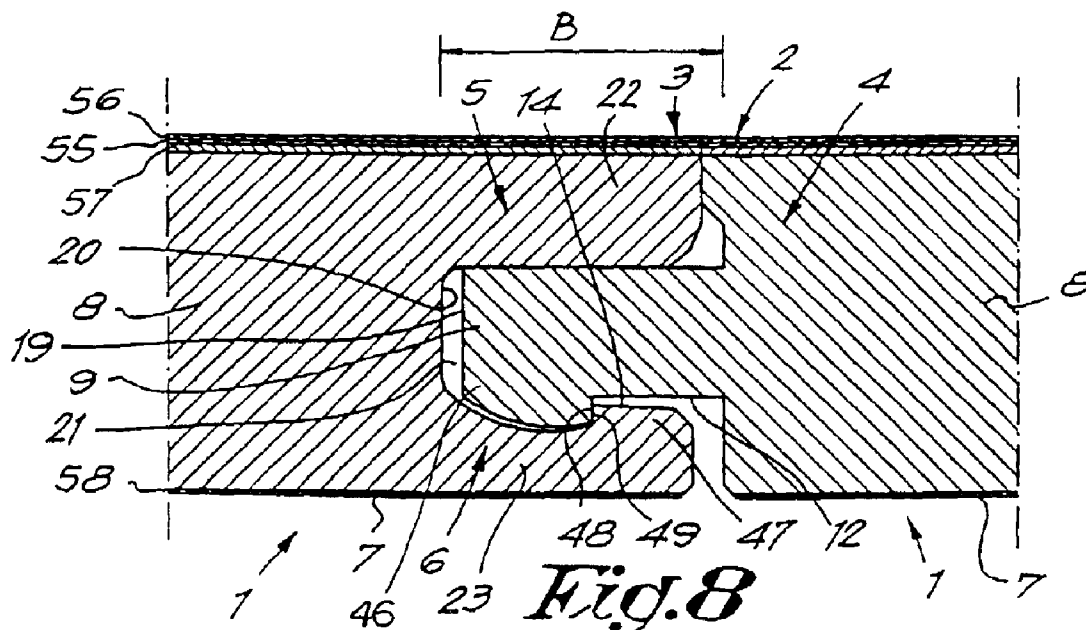
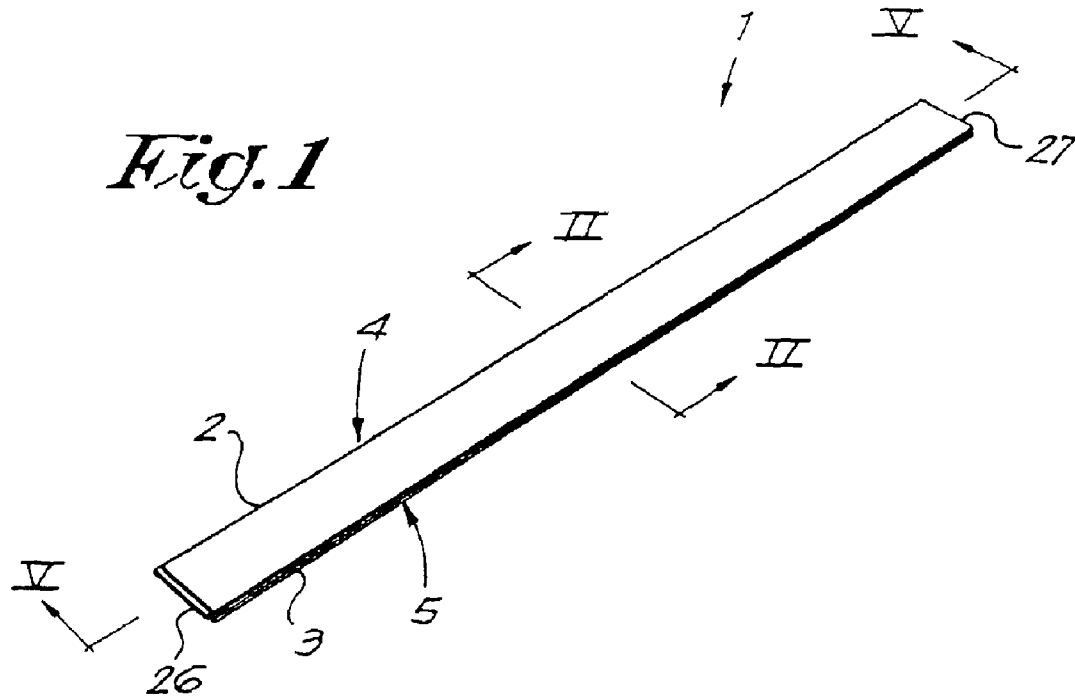
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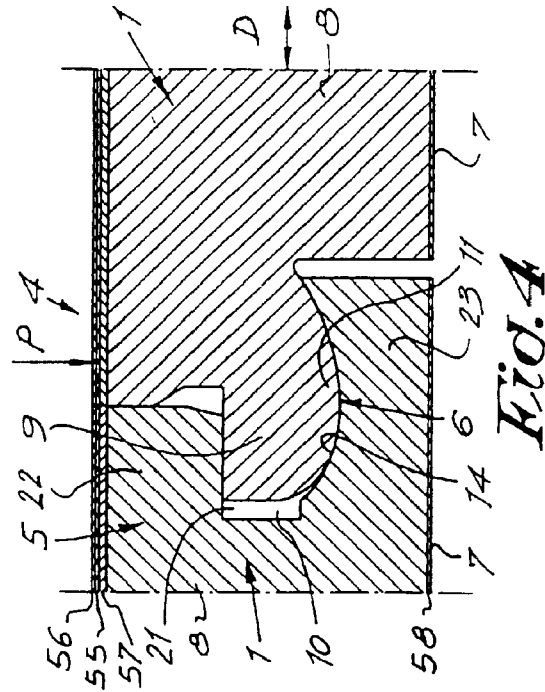
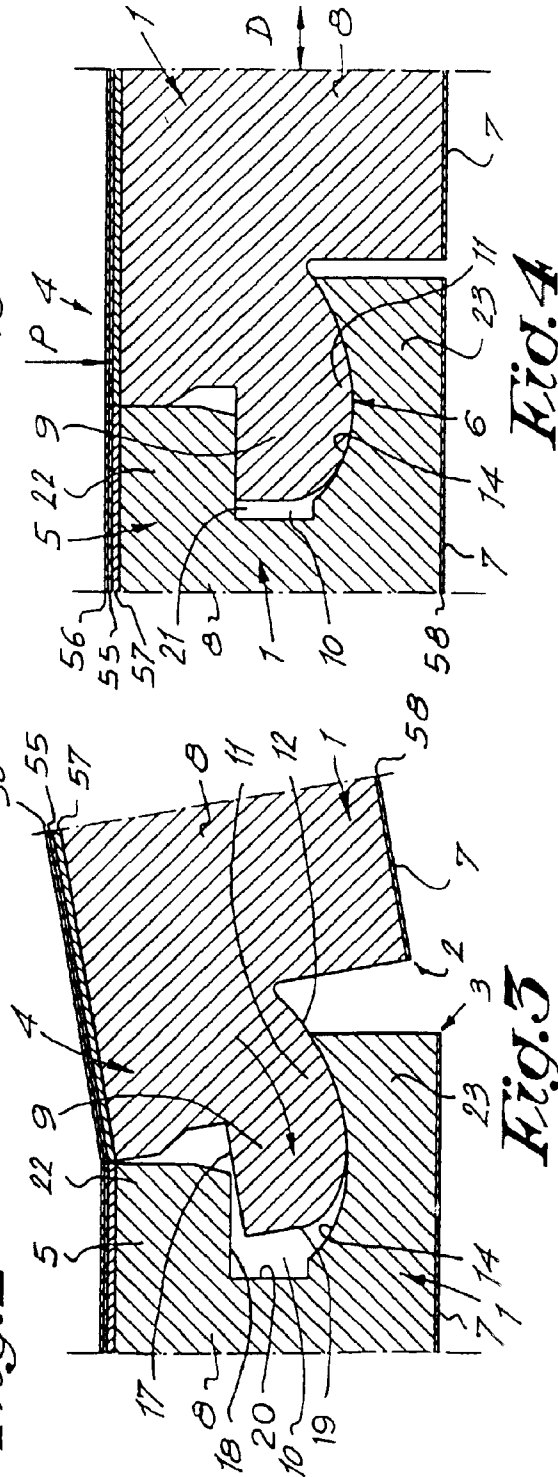
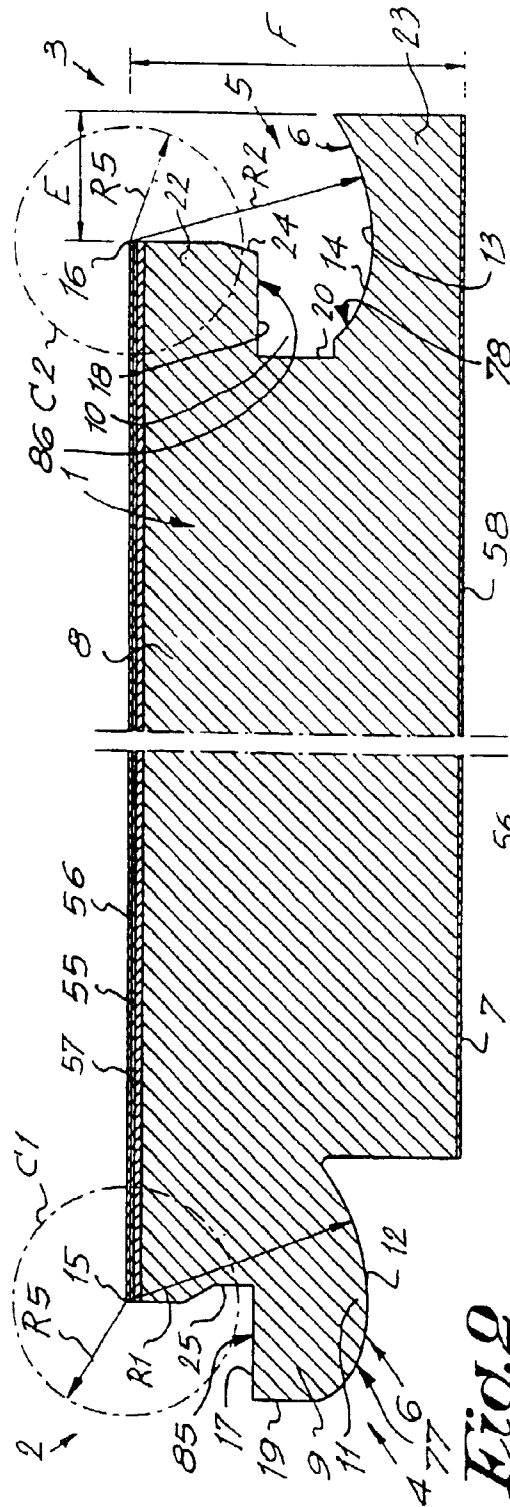
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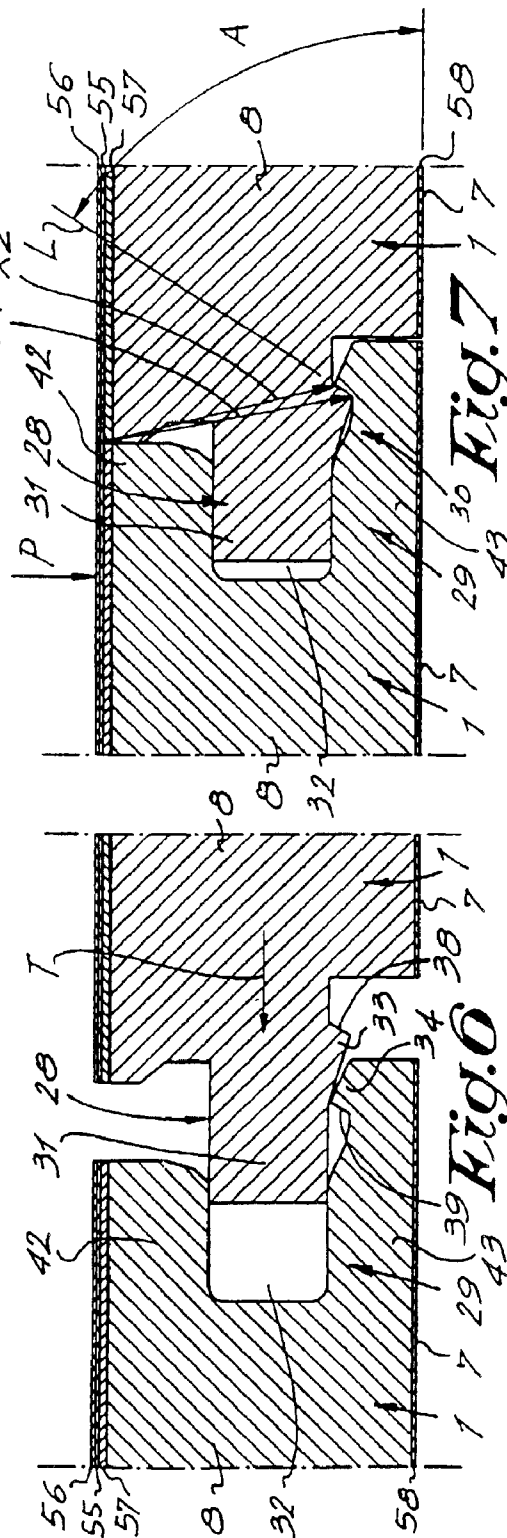
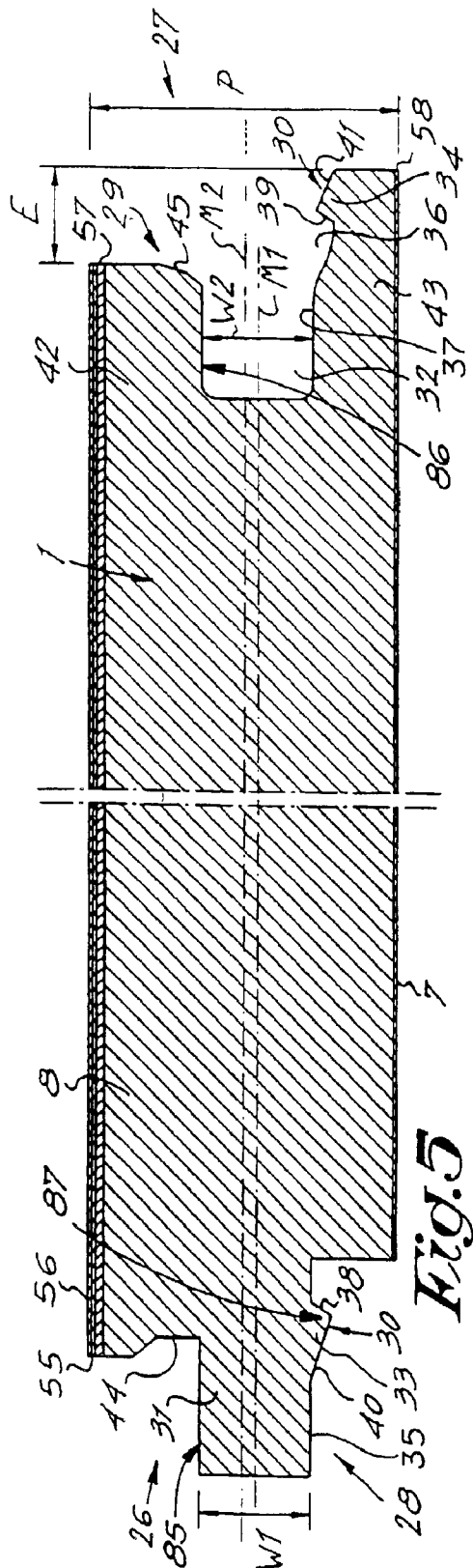
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Fig. 1







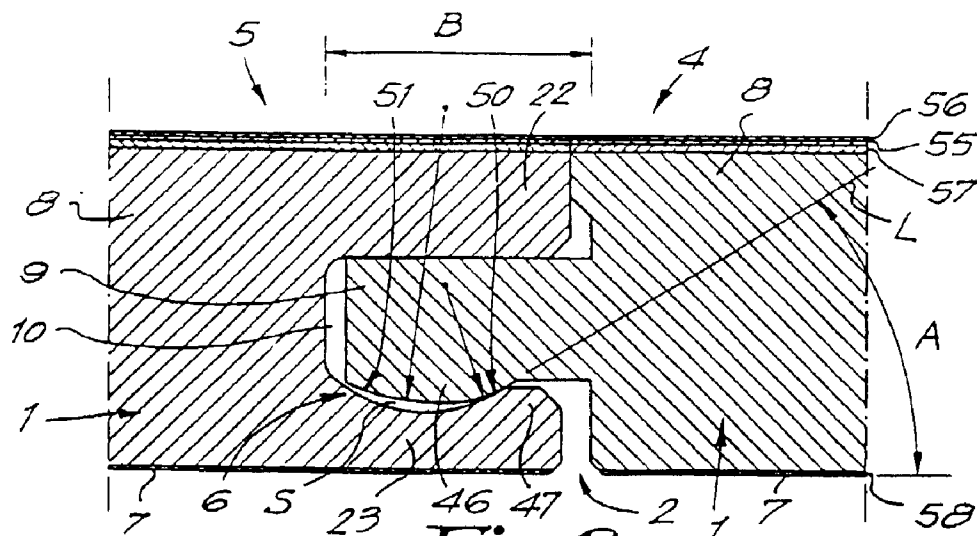


Fig. 9

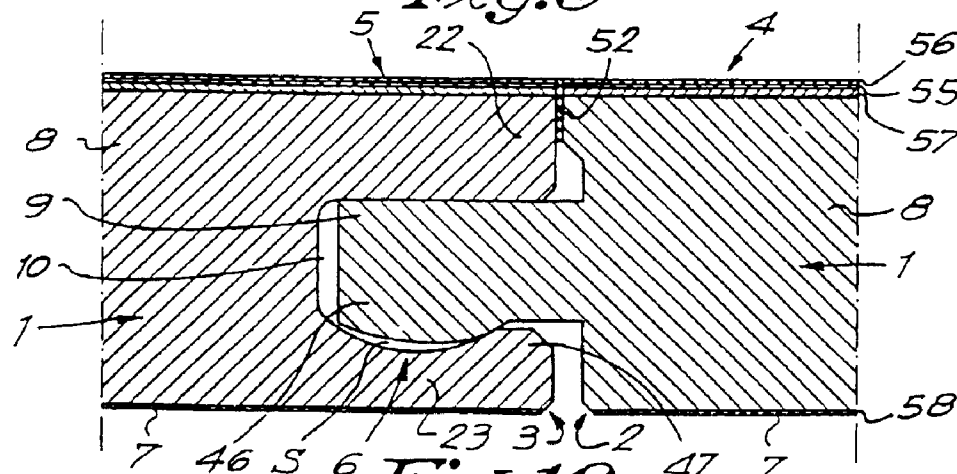


Fig.10

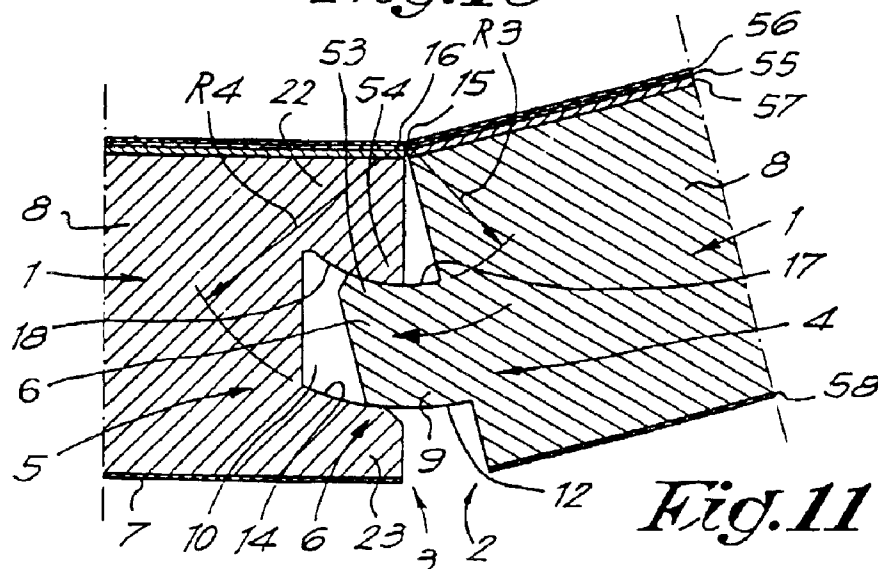


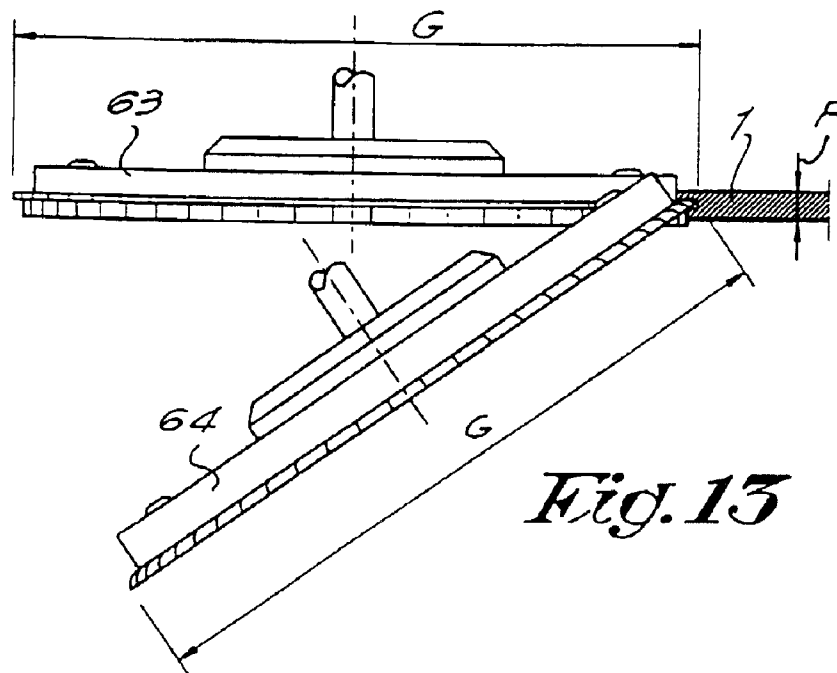
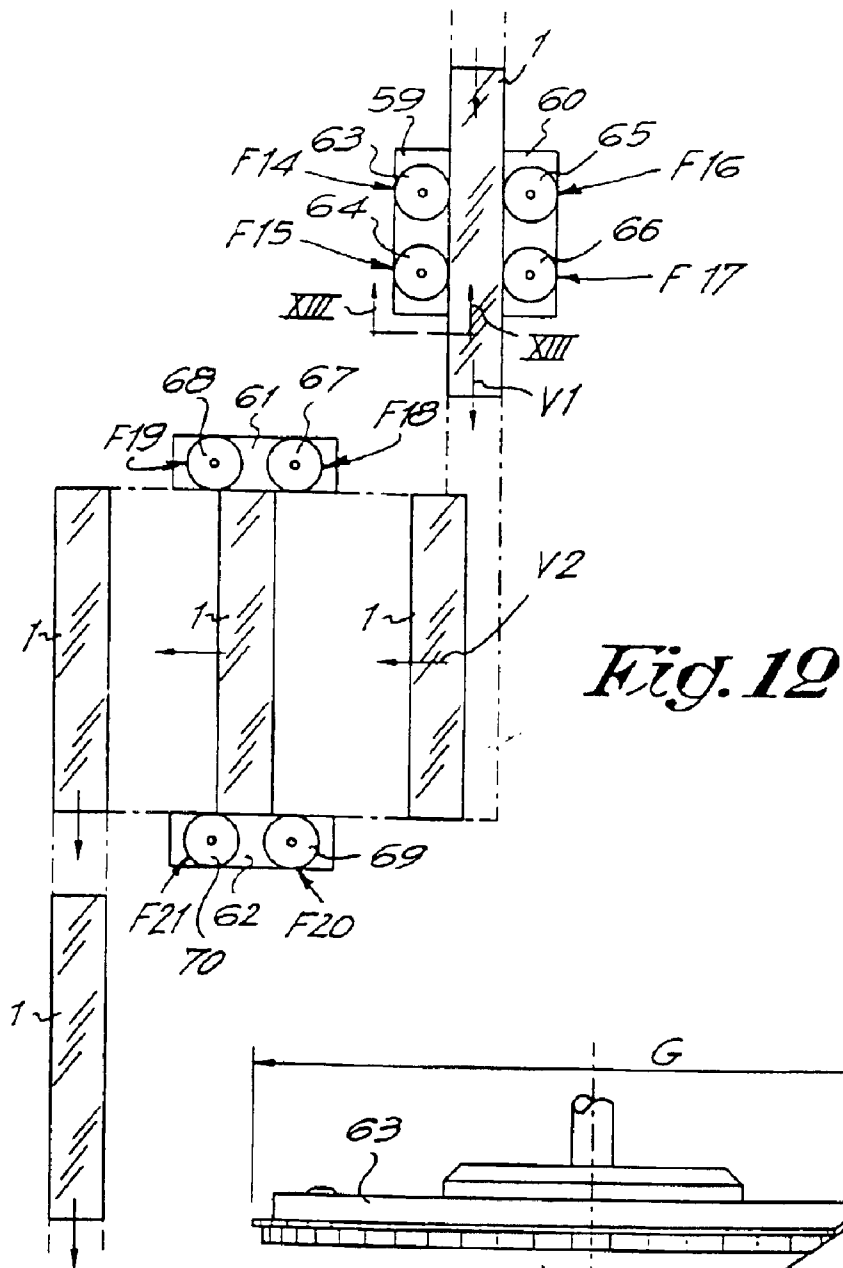
Fig. 11

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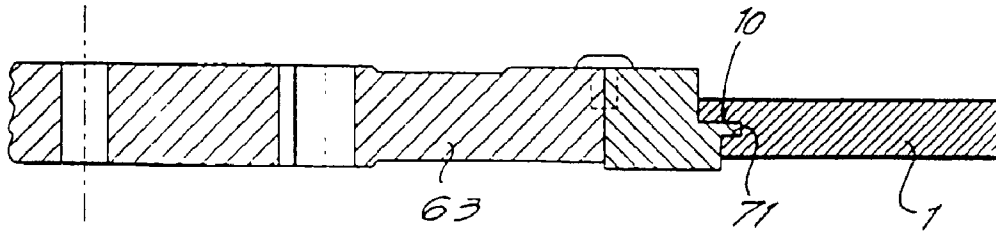


Fig. 14

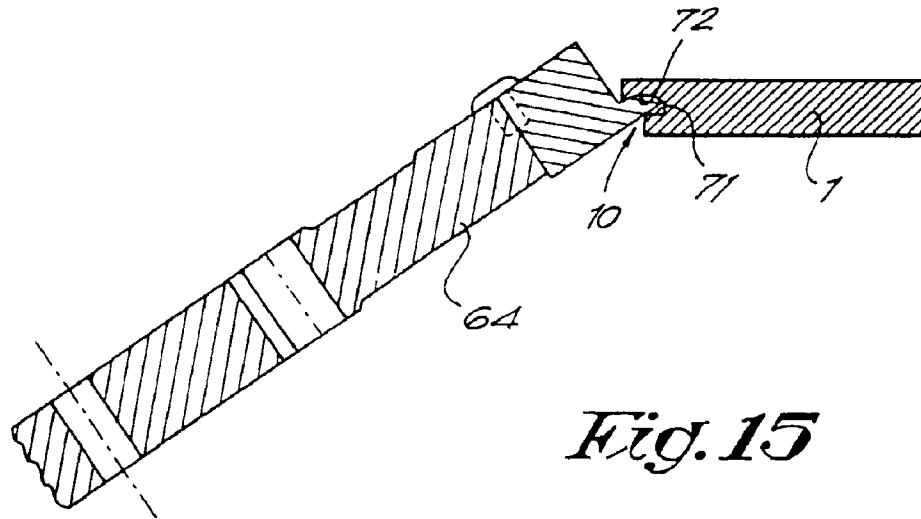


Fig. 15

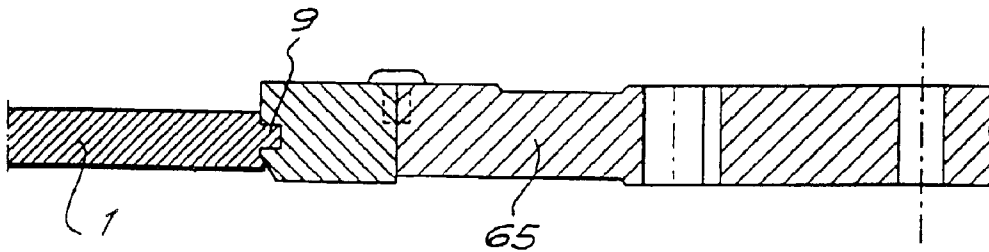


Fig. 16

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Fig. 17

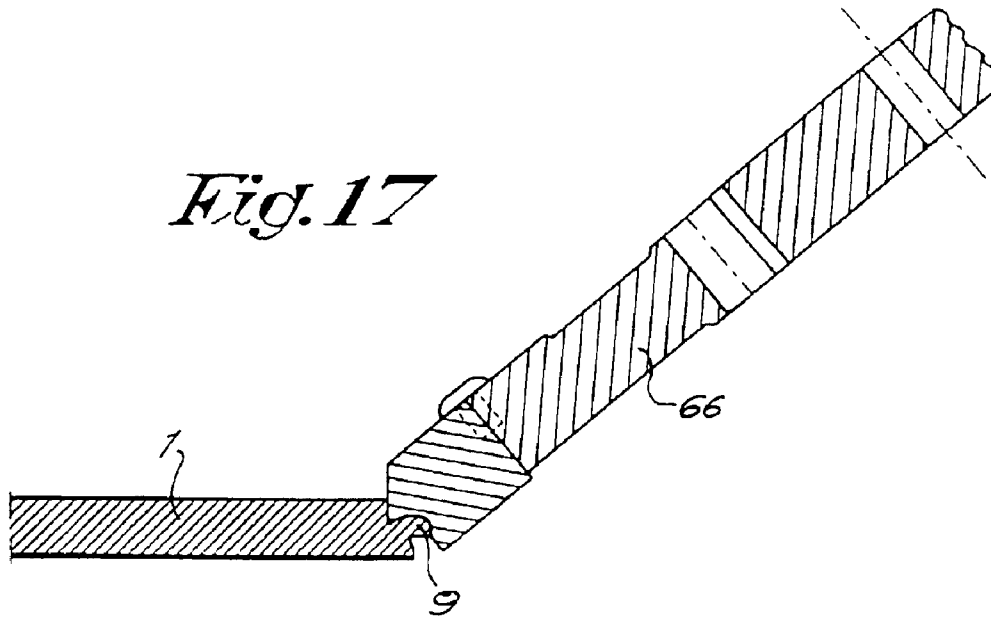


Fig. 18

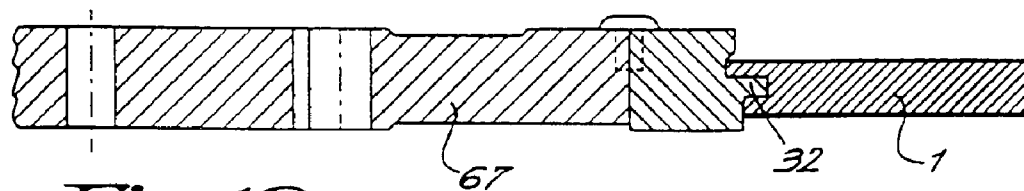
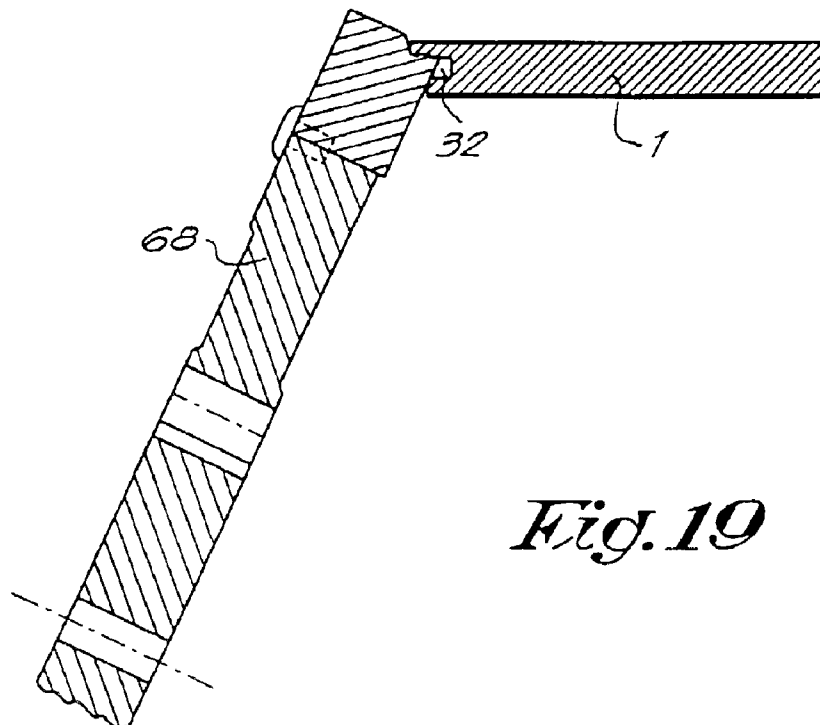


Fig. 19



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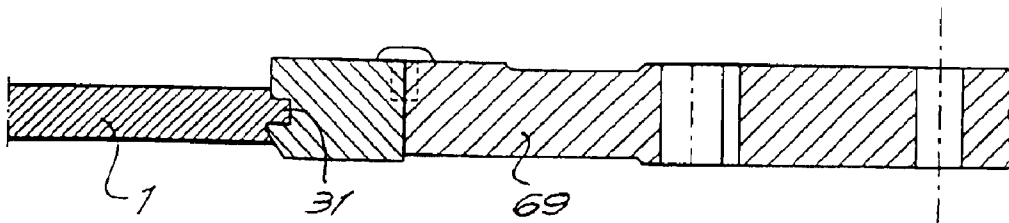


Fig. 20

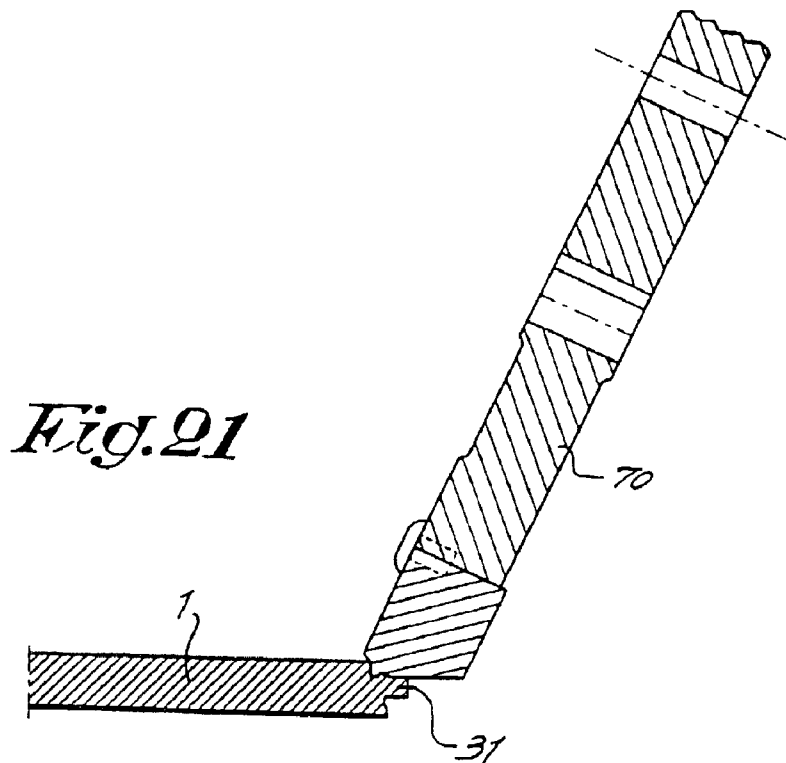
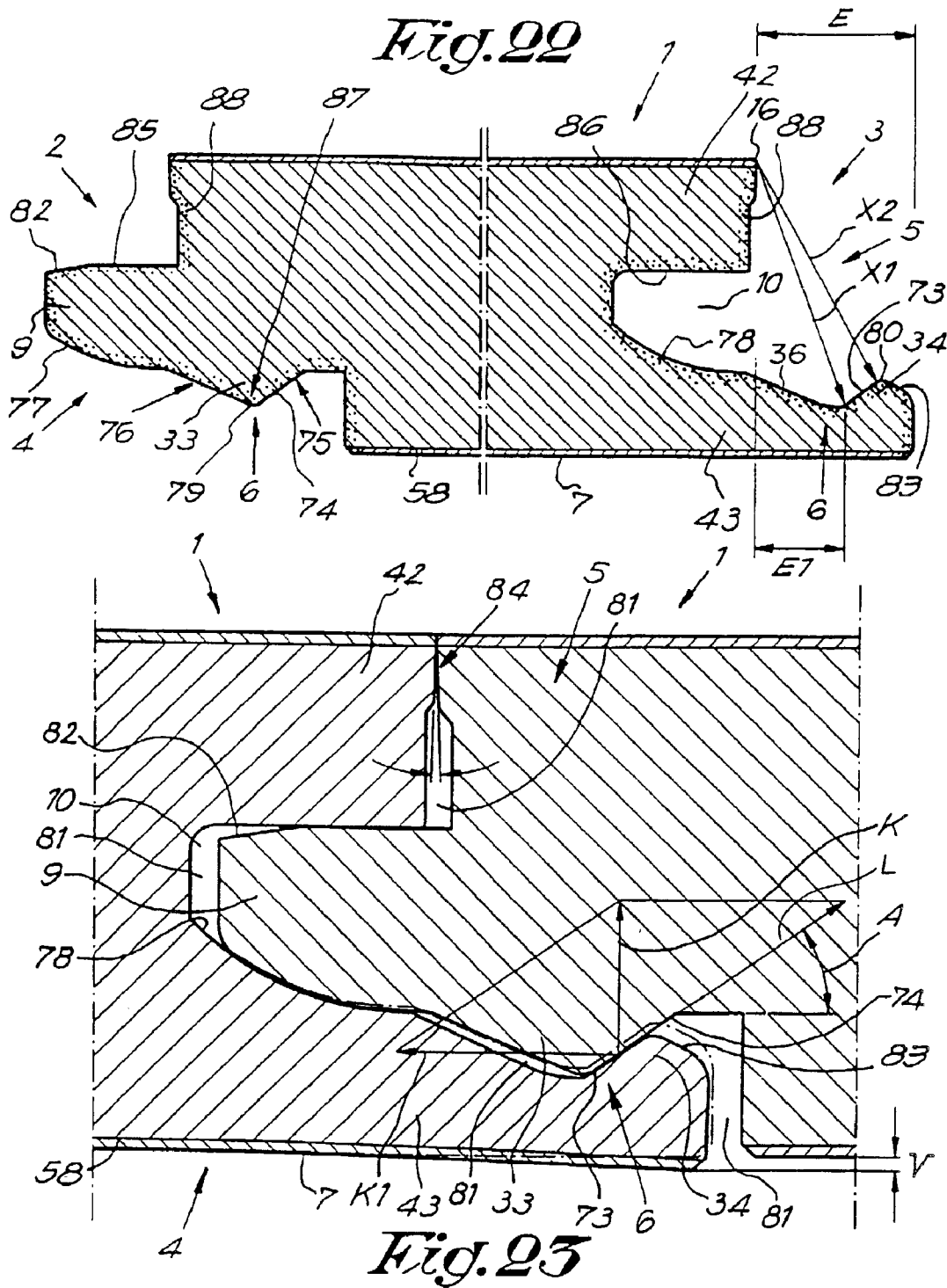
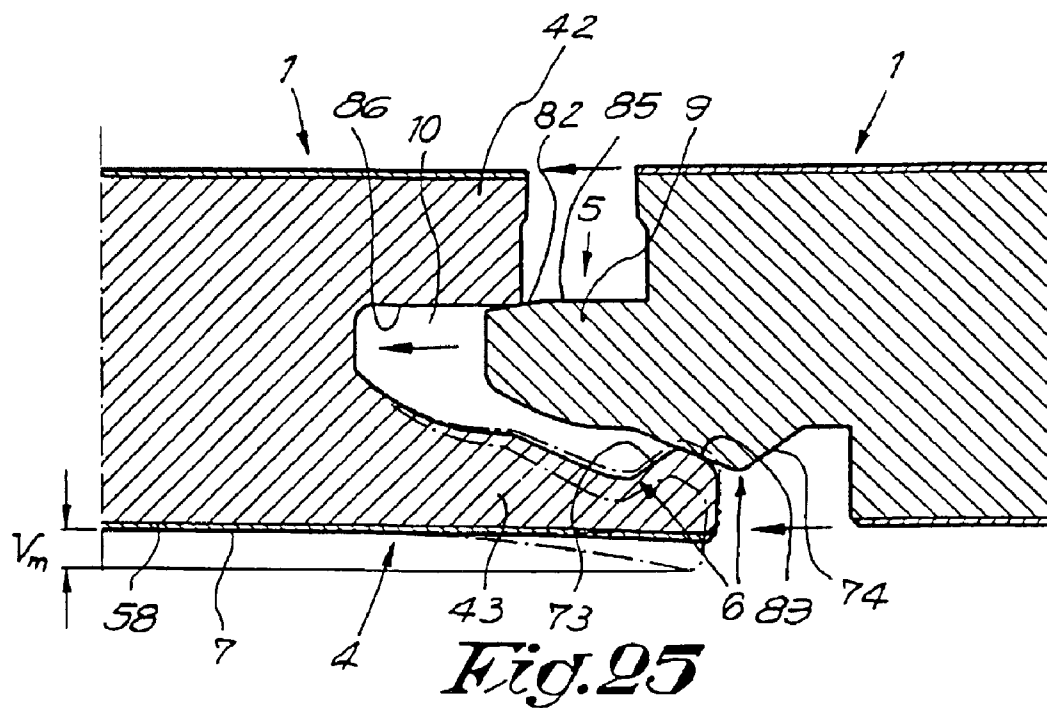
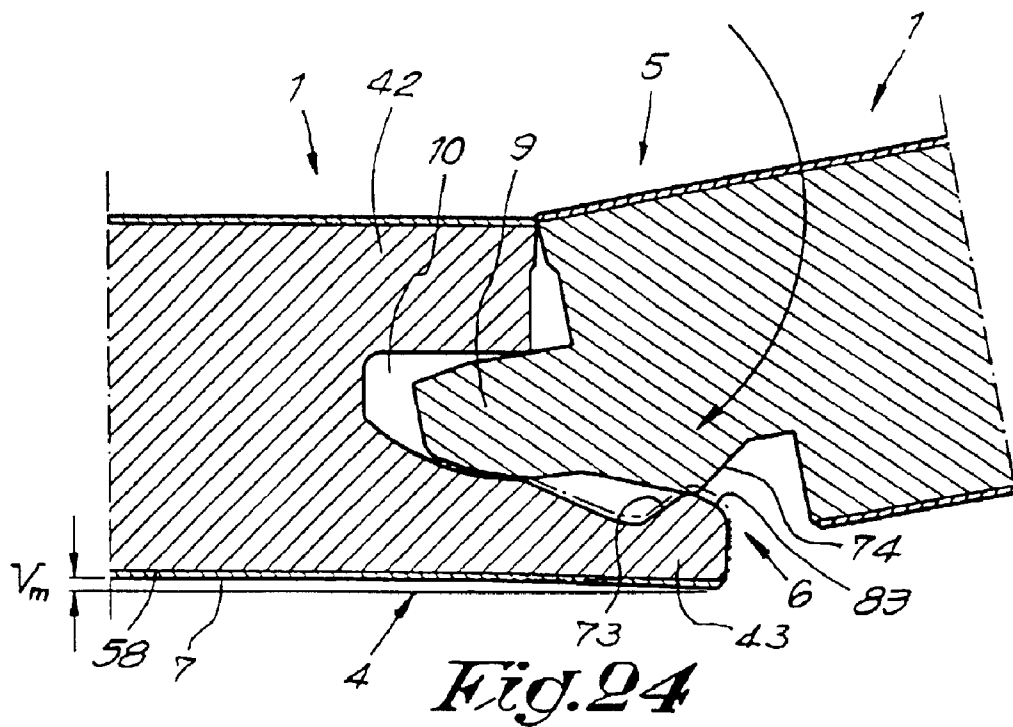


Fig. 21





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FLOOR PANELS WITH EDGE CONNECTORS**RELATED APPLICATION DATA**

This application is a continuation of application Ser. No. 09/471,014, filed Dec. 23, 1999 now U.S. Pat. No. 6,490,836; which is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997, now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION**1. Field of the Invention**

This invention relates to a floor covering made of hard floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other. e.g., from the documents U.S. Pat. No. 5,295,341, WO 96/27719 and 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact at least in WO 96/27719 well-defined plays have to be provided in order to be sure that the snapping-together is possible.

From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

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Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are

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formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles (fibers) and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is

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avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with which the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. 1 represents a floor panel of a floor covering according to the invention;

FIG. 2, on a larger scale, represents a cross-section according to line II—II in FIG. 1;

FIGS. 3 and 4 represent how two floor panels with coupling parts according to FIG. 2 match into each other;

FIG. 5, on a larger scale, represents a cross-section according to line V—V in FIG. 1;

FIGS. 6 and 7 represent how two floor panels with coupling parts according to FIG. 5 match into each other;

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FIGS. 8 to 11 represent a number of variants of coupling parts of floor panels according to the invention;

FIG. 12 schematically represents how the floor parts can be provided with coupling parts;

FIG. 13 represents a cross-section according to line XIII—XIII in FIG. 12;

FIGS. 14 to 21, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. 12 with arrows F14 to F21;

FIG. 22 represents a floor panel according to the invention;

FIG. 23, on a larger scale, represents the coupling of two floor panels of FIG. 22;

FIGS. 24 and 25 represent two manners of coupling floor panels according to FIG. 22 to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels 1, for example, such as a laminated panel as shown in FIG. 1.

These floor panels 1 can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. 1, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is, at least at the edges of two opposite sides 2-3, provided with coupling parts 4-5 which permit two adjacent identical floor panels 1 to be coupled to each other.

According to the invention, the coupling parts 4-5, as represented in the FIGS. 2 to 4, are provided with integrated mechanical locking parts or locking elements 6 which prevent the drifting or sliding apart of two coupled floor panels 1 in a direction D perpendicular to the respective sides 2-3 and parallel to the underside 7 of the coupled floor panels 1; the coupling parts 4-5 and the locking elements 6 are formed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two subsequent floor panels 1 can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel 1 can be laterally inserted into the previous; and the coupling parts 4-5 preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels 1 with an elongated shape, as represented in FIG. 1, the respective coupling parts 4-5 are located at the longitudinal sides 2-3.

The coupling parts 4-5 can be realized in various forms, although the basic forms thereof will always be formed by a tongue 9 and a groove 10.

In the form of embodiment of FIGS. 2 to 4, the related floor panel 1 is provided with coupling parts 4-5 and locking means or locking elements 6 which allow two floor panels 1 to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements 6 consist of a first locking element 11, formed by a protrusion with a bent round shape at the lower side 12 of the tongue 9, and a second locking element 13 (shown in FIG. 2), formed by a recess with a bent hollow or downwardly concave shape in the lower wall 14 of the groove 10.

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The locking elements 11-13 ensure that two floor panels 1 which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels 1 to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side 12 of locking means or locking elements 6 has a curvature with a radius R1, the center of which coincides with the respective upper edge 15 of the floor panel 1, whereas the lower wall 14 of the locking part 5 has a curvature with a radius R2 which is equal to the radius R1, but its center coincides with the respective upper edge 16. Radii R1 and R2 may also be applied which are larger or smaller than the distance to the upper edge 15, 16 respectively, and/or which differ from each other in size.

The upper side 17 of the tongue 9 and the upper wall or side 18 of the groove 10 are preferably flat and preferably are located in the horizontal plane.

The inner side 20 of the groove 10 and the front side 19 of the tongue 9 of the two interlocked floor panels 1 preferably do not fit closely against each other, such that an intermediate space 21 is created between them into which possible dust remainders or such can be pushed away by means of the tongue 9.

The tongue 9 and the groove 10 preferably have shapes which are complementary to each other, such that the tongue 9 in the engaged condition of two identical floor panels 1 precisely sits against the upper wall 18 and the lower wall 14 of the groove 10, whereby a pressure P, exerted against the upper lip 22, is received or reacted not only by this lip 22, but by the complete structure, because this pressure can be transmitted through the tongue 9 and the lower lip 23 to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer 24 on lip 22 and a recess 25 can be provided, as represented in FIGS. 2 to 4, as a result of which the subsequent floor panels 1 can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. 5 to 7, the floor panels 1 according to the invention can also, along the sides 26-27 which are at a right angle to the sides 2-3, be provided with coupling parts 28-29 which have locking elements 30, too. The coupling parts 28-29 are preferably also realized in the shape of a tongue 31 and a groove 32. Hereby, the locking elements 30 do not have to be of the same nature as the locking elements 6.

Preferably, at the sides 26-27 locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. 6 and 7. To this aim, the locking elements 30 consist of a snap-together connection with locking elements 33 and 34 which grip behind each other.

As represented in FIGS. 5 to 7, the locking element 33 preferably consists of a local sharp protrusion of the lower side 35 of the tongue 31 which can be located in a recess 36 in a lower lip 43 extending distally from the lower wall 37 of the groove 32. The locking element 34 is formed by the upward directed part or protrusion which defines the distally outer end of recess 36.

In this case, the locking elements 33-34 have contact surfaces 38-39 which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The

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common plane of tangency L which is determined by the common tangent at the meeting point or area of surfaces 38–39, hereby forms an angle A sloping inwardly and downwardly from an outer region to an inner region relative to the underside 7, which angle is smaller than 90°.

The locking elements 33–34 preferably are provided with inclined portions 40 and 41 which, when two floor panels 1 are engaged, cooperate with each other in such a manner that the locking elements 33–34 can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. 6 and 7).

The thickness W1 of the tongue 31 preferably is equal to the width W2 of the groove 32, such that compression pressure P applied to the upper lip 42 is reacted by the tongue 31 which, in its turn, then is reacted by the lower lip 43.

Analogous to the chamfer 24 and recess 25, a recess 44 and a chamfer 45 are provided also at the edges 28–29.

It is noted that such a snap-together coupling can also be applied at the edges 2–3. Hereby, this can be a snap-together coupling analogous to these of FIGS. 5 to 7, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. 8 and 9. Contrary to the locking elements 33–34 which consist of rather local protrusions, in the forms of embodiment of FIGS. 8 and 9 use is made of locking elements 46–47 which, in comparison to the total width B of the coupling, extend over a rather large distance.

In this case, the locking elements 46–47 are also provided at the lower side 12 of the tongue 9 and the lower wall 14 of the groove 10.

According to FIG. 8, the locking elements 46–47 have contact surfaces 48–49 which are at an angle with the plane of the floor panel 1. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. 9, the locking elements 46–47 possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements 46–47 hereby consist of curved surfaces. The common plane of tangency L forms an angle A which is smaller than 90°, and more preferably is smaller than 70°.

In this manner, the locking element 46 preferably has two portions with a different curvature, on one hand, a portion 50 with a strong curvature and, on the other hand, a portion 51 with a weak curvature. The portion 50 with the strong curvature provides for the formation of a firm coupling. The portion 51 with the weak curvature facilitates the coupling parts 4–5 to be brought into each other easily. The intermediate space S forms a chamber which offers space for dust and the like which, when engaging two floor panels 1, inevitably infiltrates there.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. 7 to 9, preferably the tongue 9–31 has a shape that thickens from below, which then can cooperate with a widened portion in the groove 10.

In FIG. 10, a variant is represented whereby at least at the level of the upper edges 15–16, a sealing material 52 is provided, as a result of which a watertight sealing can be assured. This sealing material 52 may consist of a strip or covering which is provided previously at the floor panel 1, either at one or both upperside edges 15–16.

In FIG. 11, a further variant is represented, whereby the locking element 6 is formed by an upward directed portion

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53 at the tongue 9, which as a result of a turning movement of the panel, is brought behind a downward-directed portion 54 on the upper wall 18. More particularly, this is obtained by forming the upper side 17 and the upper wall 18 with a curvature R3, the center of which is situated at the upperside edges 15–16, and forming the lower side 12 and the lower wall 14 with a radius R4, the center of which is also situated at the upperside edges 15 and 16, respectively. These radii R3–R4 can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius R1, R3 respectively, and, on the other hand, the radius R2, R4 respectively, preferably should not be larger than 2 mm.

It is also preferred that the center of these radii be situated inside the circle C1, C2 (see FIG. 2) respectively, which extends with a radius R5 of 3 mm centered at upperside edge 15, 16 respectively.

Finally is noted that, according to the invention, the lower lip 23–43, as represented in FIGS. 2 to 7, can be formed distally longer than the upper lip 22–42. This has an advantage that the coupling parts 4–5–28–29 can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels 1, because each subsequent floor panel 1 during installation can be placed upon the protruding lower lip 23–43, as a result of which the tongue 9–31 and the groove 10–32 automatically are positioned in front of each other.

The embodiments wherein the lower lip 23 is equal to or distally shorter than the upper lip 22, in their turn, offer the advantage that no protruding lip 23 remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference E between the distally outer edge of the upper lip 22–42 and the distally outer edge of the lower lip 23–43, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove 10, should preferably be kept smaller than one time the total thickness F of the floor panel 1. For stability's sake, normally this total thickness F shall never be less than 5 mm.

The small dimension of the difference E offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line M1 through the tongue 9 and the groove 10 is situated lower than the center line M2 of the floor panel 1, such, that the upper lip 22–42 is thicker than the lower lip 23–43. In first instance, this is essential in this kind of connection, because then it is the lower lip 23–43 which bends, whereby the upper side of the floor panel 1 is kept free of possible deformations.

As explained in the introduction, for the core 8 a material is chosen from the following series:

- a. a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;
- a product based on synthetic material;
- chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. 2 to 11, such laminated flooring preferably consists of a core 8 made of MDF medium density fiberboard board, HDF high density

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fiberboard board or similar, whereby at least at the upper side of this core **8** one or more layers of material are provided.

More particularly, it is preferred that the laminated flooring is provided with a decorative layer **55** and a protective top layer **56**. The decorative layer **55** is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer **56** preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer **57** upon which the decorative layer **55** is provided.

Preferably, also a backing layer **58** shall be applied at the underside **7**, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel **1**. This backing layer **58** may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. **12**, the tongue **9** and the groove **10**, and preferably also the tongue **31** and the groove **32** are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels **1** preferably shall be displaced by means of two sequential perpendicular movements **V1** and **V2**, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices **59–60**, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices **61–62**. During these processing, the floor panels **1** preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue **9–31** and groove **10–32** are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel **1**.

This is illustrated in FIGS. **13**, **14** and **15**, wherein it is represented how a groove **10** is realized by means of two milling cycles by means of two milling cutters **63** and **64**. FIGS. **16** and **17** represent how the tongue **9** is shaped by means of milling cutters **65** and **66**.

The FIGS. **18–19** and **20–21** represent similar views showing how the groove **32** and the tongue **31** are shaped by means of milling cutters **67–68** and **69–70**, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter **63** of FIG. **14** determines the final shape of the lower flank **71** of the groove **10**, whereas the milling cutter **64** determines the final shape of the upper flank **72**.

As mentioned in the introduction, preferably milling cutters **63** to **72** shall be used, having diameters **G** which are at least 5 times, and even better at least 20 times larger than the thickness **F** of the floor panels **1**.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. **22** to **25**, a particularly preferred form of embodiment of a floor panel **1** according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

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An important characteristic herein consists in that the coupling parts **4–5** are provided with locking elements **6** which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels **1** are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip **43**, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels **1** being forced towards each other. The resultant bending **V**, as well as the tension force **K**, are indicated in the enlargement view of FIG. **23**.

In order to obtain the tension force **K** pressing together the engaged floor panels **1**, the bendable portion, in this case the lip **43**, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface **73** which preferably can cooperate with a corresponding contact surface **74** on tongue **9**. These contact surfaces **73–74** are similar to the aforementioned contact surfaces **39–38** and also similar to the inclined portions of the lower lip of FIGS. **2** to **4**.

In the FIGS. **2** and **5**, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. **23** can be realized.

Due to, on one hand, the contact along the angle **A**, and, on the other hand, the fact that a tension force **K** is created, a compression force component **K1** is produced, as a result of which the floor panels **1** are drawn against each other in compression.

Preferably, the angle **A** of the mutual plane of tangency of contact surfaces **73–74** relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force **K** is realized, an angle **A** of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels **1** and, on the other hand, to ensure that the floor panels **1** can easily be engaged and respectively disassembled.

Although the pressing or compression force component **K1** preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending **V** is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending **V** of the lip **43** only produces local bending of the underlayer.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4–5**, including the locking elements **33–34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

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According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core 8, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. 22 to 25 consists in that the floor panels 1 can be selectively engaged by means of a turning movement, as represented in FIG. 24, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. 25, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending V_m results in the coupling parts, more particularly in the lip 43, which bending V_m is less pronounced, if not nonexistent, as in the FIGS. 2 to 4, in comparison to the bending V_m which results when the floor panels 1 are engaged by means of shifting them towards each other, as in FIG. 15.

The advantage of this consists in that the floor panels 1 can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel 1 can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts 4-5 shown in FIGS. 22 to 25 can also be used for the coupling parts 28-29 of the short sides of the panels.

According to the invention, in the case that the four sides 2-3-26-27 are provided with coupling parts 4-5-28-29, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels 1, for example, such as represented in FIG. 1, the locking at the small sides 26-27 preferably shall be more pronounced than at the longitudinal sides 2-3. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces 73-74 with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element 33, is bounded by at least two portions 75-76 (shown in FIG. 22), respectively a portion 75 with a strong (steep) inclination which provides for the locking, and a portion 76 with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. 22 to 25, these portions 75-76 are formed by straight planes, but, as already described with reference to FIG. 9, use can also be made of curved portions 50-51. In FIG. 5, these are the contact surface 38 and the inclined portion 40.

In the preferred form of the invention, the floor panels 1 comprise coupling parts 4-5 and/or 28-29 exhibiting one of the following or the combination of two or more of the following features:

a curvature 77 (shown in FIG. 22) at the lower side of the tongue 9 and/or a curvature 78 at the lower lip 43 which form a guidance when turning two floor panels 1 into each other, with the advantage that the floor panels 1 can be engaged into each other easily during installation;

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roundings 79-80 at the edges of the locking elements 33-34, with the advantages that the locking elements can easily shift over each other during their engagement, or during disassembly of the floor panels 1 and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;

dust chambers 81, or spaces 21 as in FIG. 4, between all sides, directed laterally towards each other, of the engaged floor panels 1, with the advantage that inclusions which get between the floor panels 1 during the engagement do not exert an adverse influence upon good engagement;

a shaping of the tongue 9 which is such, for example, by the presence of a chamfer 82, that the upper side of the tongue 9 becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip 42 when the floor panels 1 are pushed towards each other in substantially the same plane, as indicated in FIG. 25, with the advantage that the front extremity or end of the tongue 9 does not press against the front side of the upper lip 42 or the front edge of the bottom lip 43 when the floor panels are pushed towards each other in the same plane;

a ramp surface 83, hereinbefore also called inclined portion 41, formed at the distally outer end of the lower lip 43, with the advantage that the locking elements 33-34 shift smoothly over each other and that the lower lip 43 is bent uniformly;

in the engagement direction only one important contact point which is formed by a section 84 at the location of the upperside edges of the floor panels 1, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels 1 and that the development of openings between the floor panels 1 is counteracted;

contact surfaces 85-86, more particularly abutment surfaces, formed by the upper side of the tongue 9 and the upper side of the groove 10 which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels 1, as well as contact surfaces cooperating with each other, formed by curvatures 77-78, with the advantage that no mutual displacement in height between two engaged floor panels 1 is possible, even if the insertion depth of the tongue 9 into the groove 10 should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. 22 to 25, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. 2 to 11, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. 5 to 7 and 22 to 25, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element 6, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip 23-43 which extends beyond the distal edge of the upper lip 22-42, more particularly, the lowermost point 87 of the locking part 33 is situated under the top layer of the floor panel 1. For clarity's sake, this top layer is indicated in the FIGS. 22-25 only as a single layer.

It should be noted that the combination of features, the lower lip 23-43 extending further than the upper lip 22-42; the locking elements 6 being formed at least by means of a

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contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip 23-43 which extends distally beyond the upper lip 22-42, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact surface portion offers the advantage that the floor panels 1 can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip 23-43 adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface 39 or 73, preferably extends in such a manner that the distance between the upper edge 16 of the panel to the contact surface 39, 73 diminishes between the proximal and distal ends of the sloping contact surface 39, 73, in other words, such that, as represented in FIG. 22, the distance X2 is smaller than the distance X1. This is also the case in FIG. 7.

Still preferably, this portion only starts at a clear distance E1 from the outer edge of upper lip 42.

It is obvious that the coupling parts 22 to 25 can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels 1 are treated at their sides 2-3 and/or 26-27 with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. 22, such impregnation 88 is represented schematically. This treatment can be performed over the complete surface of the sides 2-3 and/or 26-27 or only over specific portions hereof, for example exclusively on the surfaces of the tongue 9 and the groove 10.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts 4-5 and/or 28-29 better keep their shape and strength, even if the floor panels 1 are engaged and disassembled repeatedly. In particular, if the core 8 is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels 1 can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

What is claimed is:

1. A floor covering panel comprising:

a laminated hard floor panel having a wood-based core material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges, and upper and under sides;

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said panel further comprising coupling parts being integrally made in one piece with said core material and located at both of the pairs of side edges, said coupling parts comprising a tongue, a groove and integrated locking elements, said tongue, groove and locking elements when coupled along adjacent side edges of two ones of said panel cooperating to establish a mechanical lock preventing relative movement between the coupled parts in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panels;

said coupling parts of at least one pair of opposite side edges having a form enabling coupling of the coupling parts by shifting them laterally towards each other with the panels located substantially in the same plane to couple the coupling parts of said one pair of side edges; and

wherein the coupling parts of said one pair of side edges define a snap-together coupling providing a snap-action during coupling of two panels obtained by shifting them laterally towards each other, said snap-action involving an elastic deformation of the groove and being delivered substantially entirely by said core material; and

wherein said groove of said coupling parts includes a lower lip, and wherein said snap-action involves an elastic deformation of said lower lip.

2. The floor covering panel according to claim 1, wherein said coupling parts upon coupling are secured so that they are coupled without play in the plane of coupled panels.

3. The floor covering panel according to claim 1, at least one edge of said one pair of edges comprising said lower lip, said lower lip defining at least in part a lower wall of the groove of said coupling parts and extending distally beyond a respective opening defined by the groove, said lower lip including a recess in an upper side of the lip;

wherein the opposed edge of said one pair of edges comprises a protrusion extending from an under side of the tongue of said coupling parts;

said locking elements and said snap-together coupling comprising said protrusion and recess.

4. The floor covering panel according to claim 3, wherein said recess and protrusion include arcuate portions.

5. The floor covering panel according to claim 1, including a surface densifying agent on the coupling parts and locking elements of the floor panel, including the locking elements.

6. The floor covering panel according to claim 5, wherein said side edges including the coupling parts and locking elements include said surface densifying agent thereon.

7. The floor covering panel according to claim 1, wherein said coupling parts comprise a recess located in said lower lip, said lower lip extending at least to a side edge of a respective panel; and

a protrusion provided on an under side of a tongue part of the coupling parts.

8. The floor covering panel according to said lip having a progressively increasing thickness from said recess and towards an area of the lip located proximally inwardly of the recess.

9. The floor covering panel according to claim 8, said lip area of a progressively increasing thickness extending along an area of the lower lip.

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10. The floor covering panel according to claim 1, wherein;

a lower wall of the groove defines in part said lower lip; the tongue is formed to become lodged in the groove upon lateral motion of the panels towards each other in substantially a common plane to couple the panels with the tongue becoming at least partially inserted into the groove before any deformation of the coupling parts during coupling and before any snap-action between the coupling parts.

11. The floor covering panel according to claim 10, wherein the lodging of said tongue in said groove occurs when the lateral motion of the panels is started from positions at which the panels are completely separated from each other.

12. The floor covering panel according to claim 10, wherein said tongue includes an under side adapted to slide over a distal upper portion of the lower lip when the panels are moved towards each other to establish coupling between coupling parts of the panels;

and said lower lip including a distal upper end portion that is upwardly inclined from the distal end towards a proximal direction of the lip to thereby facilitate sliding of the under side of the tongue over the distal upper end portion of the lower lip upon lateral shifting motion of the tongue and groove towards each other to couple the coupled parts.

13. The floor covering panel according to claim 10, including a planar tongue surface on an upper side of said tongue and a planar upper wall surface on an upper wall of said groove, said planar tongue and groove upper wall surfaces cooperating in contacting relationship when the coupled parts are coupled to each other to prevent drifting apart of coupled floor panels in a direction perpendicular to the plane of each panel.

14. The floor covering panel according to claim 10, wherein a distal upper end portion of the tongue includes an inclined contact surface inclined downwardly in the distal direction of the tongue, said inclined contact surface located so as to engage a distal end of an upper wall of the groove upon initial engagement between the tongue and groove when the coupling parts are coupled together.

15. A floor covering panel comprising:

a laminated hard floor panel having a wood-based core material including a material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges, and upper and under sides;

said panel further comprising coupling parts being integrally made in one piece with said core material and located along at least one of said pairs of side edges, said coupling parts comprising a tongue, a groove, and integrated locking elements, said tongue, groove and locking elements when coupled along adjacent side edges of two ones of said panel establishing a mechanical lock between the coupled parts of coupled panels and locking the coupled panels against relative movement in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panels when the coupling parts are coupled;

wherein said coupling parts of said at least one pair of opposite side edges are formed to enable coupling of two ones of said floor panel by shifting them laterally towards each other to couple the coupling parts of said

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at least one pair of side edges with the panels located substantially in the same plane;

wherein the coupling parts of said at least one pair of side edges define a snap-together coupling providing a snap-action during coupling of two panels obtained by shifting them laterally towards each other, said snap-action involving an elastic deformation of the groove.

16. The floor covering panel according to claim 15, wherein said locking elements comprise a recess located on the upper side of a lip defined at least in part by a lower wall of said groove and a protrusion extending downward from the under side of said tongue;

a planar tongue surface on an upper side of said tongue and a planar upper wall surface on an upper wall of said groove, said planar tongue and groove upper wall surfaces cooperating in contacting relationship upon coupling of said coupled parts to prevent relative motion of coupled floor panels in a direction perpendicular to the plane of each panel.

17. The floor covering panel according to claim 16, wherein said lip progressively increases in thickness along at least a portion of said area of the lip defining at least in part a lower wall of said groove.

18. The floor covering panel according to claim 16, wherein said under side of said tongue includes an arcuate portion between said protrusion and a distal end portion of said tongue.

19. The floor covering panel according to claim 15, wherein said coupling parts upon coupling are secured so that they are coupled without play in the plane of coupled panels.

20. A floor covering panel comprising:

a laminated hard floor panel having a wood-based core comprising HDF/MDF material, said panel further comprising a first pair and a second pair of opposed side edges, and upper and under sides;

said panel further comprising coupling parts integrally made in one piece with said core material and located at both of the pairs of side edges, said coupling parts comprising a tongue, a groove, and integrated locking elements, said tongue, groove and locking elements when coupled along adjacent side edges of two ones of said panel cooperating to establish a mechanical lock preventing relative movement between the coupled parts of coupled panels in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panels;

said coupling parts of at least one pair of opposite side edges having a form enabling coupling of two ones of said floor panel by shifting them laterally towards each other with the panels located substantially in the same plane; and

wherein the coupling parts of said one pair of side edges define a snap-together coupling providing a snap-action during coupling of two panels obtained by shifting them laterally towards each other, said snap-action involving an elastic deformation of the groove;

at least one edge of said one pair of edges comprising a lower lip defining at least in part a lower side wall of the groove of said coupling parts and extending distally beyond an upper lip of the groove, said lower lip including a recess in an upper side of the lower lip;

wherein an opposed edge of said one pair of edges comprises a tongue comprising said coupling parts, said tongue including a protrusion extending from an under side of the tongue;

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said protrusion and recess comprising said snap-together coupling, and snap-fitting together upon laterally shifting and coupling the coupling parts;

said lower lip having an area of progressively increasing thickness along an area of said lower lip extending proximally relative to said recess.

21. The floor covering panel according to claim 20, wherein said lower lip area of progressively increasing thickness extends along at least a portion of said lower lip defining said lower wall of said groove.

22. A flooring panel according to claim 20, wherein said snap-action involves an elastic deformation of said lower lip.

23. A floor covering panel formed of HDF/MDF core material:

said panel having upper and under sides, and comprising at least two opposed side edges monolithically formed of said core material, said at least two side edges having coupling parts monolithically formed in the core material of each of said side edges;

one of said side edges including a tongue comprising one of said coupling parts and the other of said side edges having a groove with at least one lip comprising another of said coupling parts, said lip being elastically deflectable relative to said panel such that when the coupling parts of adjacent side edges of two of said panels are coupled, the coupled coupling parts define integral snap-fit mechanical locking elements;

said locking elements preventing drifting apart of coupled floor panels in a direction perpendicular to the plane of the coupled panels and in a direction parallel to a plane including the coupled panels and perpendicular to the coupled edges.

24. The floor covering panel according to claim 23, wherein the snap-fit mechanical locking elements include a locking protrusion defined on the tongue and a cooperating recess defined in the groove.

25. The floor covering panel according to claim 24, wherein the locking protrusion is defined on a lower side of said tongue.

26. The floor covering panel according to claim 24, wherein said at least one lip is a lower lip, and the groove includes an upper lip, said lower lip extending distally beyond the upper lip.

27. The floor covering panel according to claim 26, wherein the cooperating recess formed in the lower lip further defines a portion of a clearance that is established when the coupling parts are coupled.

28. The floor covering panel according to claim 25, wherein the locking protrusion extends substantially downward from the under side of the tongue and the recess defined in the groove is oriented in juxtaposed alignment with the locking protrusion when the coupling parts are coupled.

29. The floor covering panel according to claim 23, wherein said coupling parts upon coupling are secured so that they are coupled without play in the plane of coupled panels.

30. The floor covering panel according to claim 23, wherein at least one clearance is formed at a portion of an area between the tongue and groove of adjacent coupled coupling parts, and wherein said coupling parts upon coupling are secured so that they are coupled without play in the plane of coupled panels.

31. The floor covering panel according to claim 23, wherein said at least one lip is a lower lip, and the lower lip has a cross-section configuration uniform along the panel

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edge and has a non-uniform thickness between upper and under sides thereof.

32. The floor covering panel according to claim 24, wherein the respective tongue and groove of coupled coupling parts snap-fit together when coupled by shifting them laterally towards each other in a substantially common plane.

33. The floor covering panel according to claim 24, wherein the respective tongue and groove of coupled coupling parts exhibit snap-action when coupled or uncoupled by rotational motion relative to one another about an axis extending parallel to said adjacent side edges.

34. The floor covering panel according to claim 33, wherein the groove of coupled coupling parts defines at least one portion of a clearance adjacent at least one area of contact between said tongue and groove.

35. The floor covering panel according to claim 24, wherein the at least one lip is a lower lip and the groove includes an upper lip, each lip extending distally substantially the same length.

36. The floor covering panel according to claim 23, further comprising other coupling parts monolithically formed in the core material of the other pair of opposed side edges of the panel, said other coupling parts including a tongue and groove.

37. The floor covering panel according to claim 36, wherein the tongue and groove of the other coupling parts include monolithically formed mechanical locking elements.

38. The floor covering panel according to claim 37, wherein the groove includes upper and lower lips, said lower lip extending distally beyond said upper lip.

39. The floor covering panel according to claim 38, wherein the groove includes upper and lower lips, and the locking elements include a locking protrusion provided in an under side of the tongue and a cooperating recess defined in the lower lip.

40. The floor covering panel according to claim 36, wherein at least one clearance is formed at a portion of an area between the tongue and groove of adjacent coupled coupling parts.

41. The floor covering panel according to claim 37, wherein the groove includes upper and lower lips, wherein the lower lip has a cross-section configuration uniform along the respective panel edge and has a non-uniform thickness between upper and under sides thereof.

42. The floor covering panel according to claim 37, wherein the at least one lip is a lower lip, and at least a distal end portion of the lower lip is elastically bendable relative to a proximal end portion of the lower lip.

43. The floor covering panel according to claim 42, wherein the respective tongue and groove of coupled coupling parts snap-fit together when coupled by shifting them laterally towards each other in a substantially common plane.

44. The floor covering panel according to claim 36, wherein the respective tongue and groove of coupled coupling parts of said opposed pairs of side edges exhibit snap-action when coupled or uncoupled by rotational motion relative to one another about an axis extending parallel to said adjacent side edges.

45. A floor covering panel comprising:

a laminated hard floor panel having a wood-based core material including a material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges, and upper and under sides;

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said panel further comprising coupling parts being integrally made in one piece with said core material and located along at least one of said pairs of side edges, said coupling parts comprising a tongue, a groove, and integrated locking elements, said tongue, groove and locking elements when coupled along adjacent side edges of two ones of said panel establishing a mechanical lock between the coupled parts of coupled panels and locking the coupled panels against relative movement in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panels when the coupling parts are coupled;

wherein said coupling parts of said at least one pair of opposite side edges are formed to enable coupling of two ones of said floor panel by shifting them laterally towards each other to couple the coupling parts of said at least one pair of side edges with the panels located substantially in the same plane;

wherein the coupling parts of said at least one pair of side edges define a snap-together coupling providing a snap-action during coupling of two panels obtained by shifting them laterally towards each other, said snap-action involving an elastic deformation of the groove;

wherein said locking elements comprise a recess located on the upper side of a lip defined at least in part by a lower wall of said groove and a protrusion extending downward from the under side of said tongue;

a planar tongue surface on an upper side of said tongue and a planar upper wall surface on an upper wall of said groove, said planar tongue and groove upper wall surfaces cooperating in contacting relationship upon coupling of said coupled parts to prevent relative motion of coupled floor panels in a direction perpendicular to the plane of each panel;

wherein said under side of said tongue includes an arcuate portion between said protrusion and a distal end portion of said tongue; and

wherein said protrusion is a local sharp protrusion.

46. A floor covering panel comprising:

a laminated hard floor panel having a wood-based core material including a material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges, and upper and under sides;

said panel further comprising coupling parts being integrally made in one piece with said core material and located along at least one of said pairs of side edges, said coupling parts comprising a tongue, a groove, and integrated locking elements, said tongue, groove and locking elements when coupled along adjacent side edges of two ones of said panel establishing a mechanical lock between the coupled parts of coupled panels and locking the coupled panels against relative movement in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panels when the coupling parts are coupled;

wherein said coupling parts of said at least one pair of opposite side edges are formed to enable coupling of two ones of said floor panel by shifting them laterally towards each other to couple the coupling parts of said at least one pair of side edges with the panels located substantially in the same plane;

wherein the coupling parts of said at least one pair of side edges define a snap-together coupling providing a

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snap-action during coupling of two panels obtained by shifting them laterally towards each other, said snap-action involving an elastic deformation of the groove;

wherein said locking elements comprise a recess located on the upper side of a lip defined at least in part by a lower wall of said groove and a protrusion extending downward from the under side of said tongue;

a planar tongue surface on an upper side of said tongue and a planar upper wall surface on an upper wall of said groove, said planar tongue and groove upper wall surfaces cooperating in contacting relationship upon coupling of said coupled parts to prevent relative motion of coupled floor panels in a direction perpendicular to the plane of each panel; and

wherein said under side of said tongue includes an arcuate portion, said arcuate portion defining said protrusion.

47. A floor covering panel comprising:

a laminated hard floor panel having a wood-based core material including a material selected from the group consisting of High Density Fibreboard (HDF) and Medium Density Fibreboard (MDF), said panel comprising a first pair and a second pair of opposed side edges, and upper and under sides;

said panel further comprising coupling parts being integrally made in one piece with said core material and located along at least one of said pairs of side edges, said coupling parts comprising a tongue, a groove, and integrated locking elements, said tongue, groove and locking elements when coupled along adjacent side edges of two ones of said panel establishing a mechanical lock between the coupled parts of coupled panels and locking the coupled panels against relative movement in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panels when the coupling parts are coupled;

wherein said coupling parts of said at least one pair of opposite side edges are formed to enable coupling of two ones of said floor panel by shifting them laterally towards each other to couple the coupling parts of said at least one pair of side edges with the panels located substantially in the same plane;

wherein the coupling parts of said at least one pair of side edges define a snap-together coupling providing a snap-action during coupling of two panels obtained by shifting them laterally towards each other, said snap-action involving an elastic deformation of the groove;

wherein said locking elements comprise a recess located on the upper side of a lip defined at least in part by a lower wall of said groove and a protrusion extending downward from the under side of said tongue;

a planar tongue surface on an upper side of said tongue and a planar upper wall surface on an upper wall of said groove, said planar tongue and groove upper wall surfaces cooperating in contacting relationship upon coupling of said coupled parts to prevent relative motion of coupled floor panels in a direction perpendicular to the plane of each panel; and

wherein said protrusion is a local sharp protrusion and wherein said lip defines in part a lower wall of said groove, said lip and lower wall progressively increasing in thickness between said recess and an area of said lip located within said groove at proximally inner area of said lip.

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48. A floor covering panel comprising:

a laminated hard floor panel having a wood-based core comprising HDF/MDF material, said panel further comprising a first pair and a second pair of opposed side edges, and upper and under sides;

said panel further comprising coupling parts integrally made in one piece with said core material and located at both of the pairs of side edges, said coupling parts comprising a tongue, a groove, and integrated locking elements, said tongue, groove and locking elements when coupled along adjacent side edges of two ones of said panel cooperating to establish a mechanical lock preventing relative movement between the coupled parts of coupled panels in a direction perpendicular to the plane of the panel as well as in a direction perpendicular to the side edges and parallel to a plane including the panels;

said coupling parts of at least one pair of opposite side edges having a form enabling coupling of two ones of said floor panel by shifting them laterally towards each other with the panels located substantially in the same plane; and

wherein the coupling parts of said one pair of side edges define a snap-together coupling providing a snap-action during coupling of two panels obtained by shifting them laterally towards each other, said snap-action involving an elastic deformation of the groove;

at least one edge of said one pair of edges comprising a lower lip defining at least in part a lower side wall of the groove of said coupling parts and extending distally beyond an upper lip of the groove, said lower lip including a recess in an upper side of the lower lip;

wherein an opposed edge of said one pair of edges comprises a tongue comprising said coupling parts, said tongue including a protrusion extending from an under side of the tongue;

said protrusion and recess comprising said snap-together coupling, and snap-fitting together upon laterally shifting and coupling the coupling parts;

said lower lip having an area of progressively increasing thickness along an area of said lower lip extending proximally relative to said recess;

wherein said lower lip area of progressively increasing thickness extends along at least a portion of said lower lip defining said lower wall of said groove;

wherein said snap-action involves an elastic deformation of said lower lip; and

wherein upon coupling of said coupling parts said lower lip remains slightly bent relative to a relaxed, non-deformed position of the lower lip.

49. A floor covering panel formed of HDF/MDF core material:

said panel having upper and under sides, and comprising at least two opposed side edges monolithically formed of said core material, said at least two side edges having coupling parts monolithically formed in the core material of each of said side edges;

one of said side edges including a tongue comprising one of said coupling parts and the other of said side edges having a groove with at least one lip comprising another of said coupling parts, said lip being elastically deflectable relative to said panel such that when the coupling parts of adjacent side edges of two of said panels are coupled, the coupled coupling parts define integral snap-fit mechanical locking elements;

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said locking elements preventing drifting apart of coupled floor panels in a direction perpendicular to the plane of the coupled panels and in a direction parallel to a plane including the coupled panels and perpendicular to the coupled edges;

wherein the snap-fit mechanical locking elements include a locking protrusion defined on the tongue and a cooperating recess defined in the groove; and

wherein the locking protrusion is in the form of a local sharp protrusion on the under side of said tongue.

50. A floor covering panel formed of HDF/MDF core material:

said panel having upper and under sides, and comprising at least two opposed side edges monolithically formed of said core material, said at least two side edges having coupling parts monolithically formed in the core material of each of said side edges;

one of said side edges including a tongue comprising one of said coupling parts and the other of said side edges having a groove with at least one lip comprising another of said coupling parts, said lip being elastically deflectable relative to said panel such that when the coupling parts of adjacent side edges of two of said panels are coupled, the coupled coupling parts define integral snap-fit mechanical locking elements;

said locking elements preventing drifting apart of coupled floor panels in a direction perpendicular to the plane of the coupled panels and in a direction parallel to a plane including the coupled panels and perpendicular to the coupled edges;

wherein the snap-fit mechanical locking elements include a locking protrusion defined on the tongue and a cooperating recess defined in the groove; and

wherein the locking protrusion on said tongue has a profile including an apex.

51. The floor covering panel according to claim 50, wherein the locking protrusion includes a first and second sloping surface extending from said apex.

52. The floor covering panel according to claim 51, wherein the slope of the first sloping surface relative to the tongue is greater than the slope of the second sloping surface relative to the tongue.

53. A floor covering panel formed of HDF/MDF core material:

said panel having upper and under sides, and comprising at least two opposed side edges monolithically formed of said core material, said at least two side edges having coupling parts monolithically formed in the core material of each of said side edges;

one of said side edges including a tongue comprising one of said coupling parts and the other of said side edges having a groove with at least one lip comprising another of said coupling parts, said lip being elastically deflectable relative to said panel such that when the coupling parts of adjacent side edges of two of said panels are coupled, the coupled coupling parts define integral snap-fit mechanical locking elements;

said locking elements preventing drifting apart of coupled floor panels in a direction perpendicular to the plane of the coupled panels and in a direction parallel to a plane including the coupled panels and perpendicular to the coupled edges;

wherein the snap-fit mechanical locking elements include a locking protrusion defined on the tongue and a cooperating recess defined in the groove; and

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the locking protrusion is substantially triangular in shape.
54. A floor covering panel formed of HDF/MDF core material:

said panel having upper and under sides, and comprising
 at least two opposed side edges monolithically formed
 of said core material, said at least two side edges having
 coupling parts monolithically formed in the core material
 of each of said side edges;

one of said side edges including a tongue comprising one
 of said coupling parts and the other of said side edges
 having a groove with at least one lip comprising
 another of said coupling parts, said lip being elastically
 deflectable relative to said panel such that when the
 coupling parts of adjacent side edges of two of said
 panels are coupled, the coupled coupling parts define
 integral snap-fit mechanical locking elements;

said locking elements preventing drifting apart of coupled
 floor panels in a direction perpendicular to the plane of
 the coupled panels and in a direction parallel to a plane
 including the coupled panels and perpendicular to the
 coupled edges;

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wherein at least one lip is a lower lip, and the lower lip has
 a cross-section configuration uniform along the panel
 edge and has a non-uniform thickness between upper
 and under sides thereof; and

wherein the lower lip is thicker at a proximal portion of
 the groove and becomes non-uniformly thinner in a
 direction extending distally away from said proximal
 portion over at least a portion of its length.

55. The floor covering panel according to any one of
 claims **15**, **20**, **45**, **46**, **47**, **48**, **49**, **50**, **53**, or **54**, wherein the
 coupling parts upon coupling are secured so they are
 coupled without play in the plane of the coupled panels.

56. The floor covering panel according to claim **54**,
 wherein the locking protrusion on said tongue includes an
 apex in juxtaposed alignment with a cooperating recess
 formed in the lip when the coupling parts are coupled.

57. The floor covering panel according to claim **54**,
 wherein at least a distal end portion of the lower lip is
 elastically bendable relative to a proximal end portion of the
 lower lip.

* * * * *

EXHIBIT H

(12) **United States Patent**
Moriau et al.

(10) **Patent No.:** **US 7,328,536 B2**
(45) **Date of Patent:** **Feb. 12, 2008**

(54) **FLOOR PANELS WITH EDGE CONNECTORS**

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patent is extended or adjusted under 35
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(21) Appl. No.: **11/449,667**

(22) Filed: **Jun. 9, 2006**

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7,040,068, which is a continuation of application No.
09/471,014, filed on Dec. 23, 1999, now Pat. No.
6,490,836, which is a continuation of application No.
08/872,044, filed on Jun. 10, 1997, now Pat. No.
6,006,486.

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Jun. 11, 1996 (BE) 9600527
Apr. 15, 1997 (BE) 9700344

(51) **Int. Cl.**
E04B 2/00 (2006.01)

(52) **U.S. Cl.** **52/588.1; 52/586.1; 52/586.2**

(58) **Field of Classification Search** 52/588.1,
52/578, 586.1, 586.2
See application file for complete search history.

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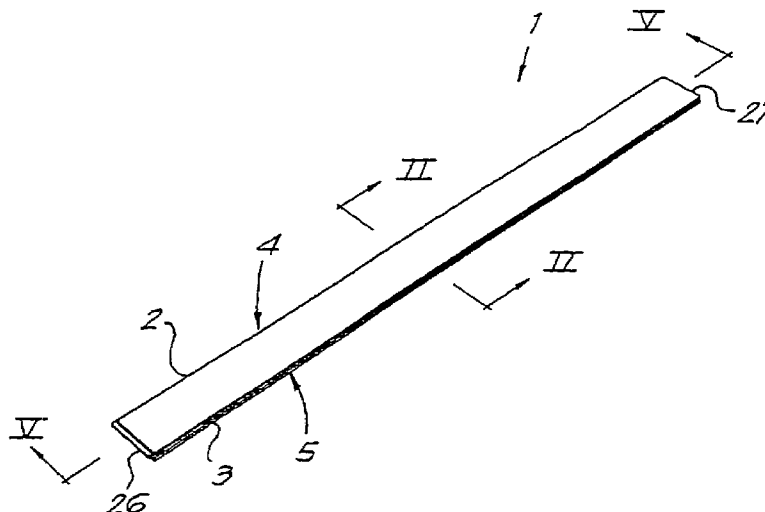
Primary Examiner—Basil Katchevs

(74) *Attorney, Agent, or Firm*—Bacon & Thomas, PLLC

(57) **ABSTRACT**

Floor covering, including hard floor panels which, at least at the edges of two opposite sides, are provided with coupling parts, cooperating with each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels in a direction (R) perpendicular to the related edges and parallel to the underside of the coupled floor panels, and provide a snap-action coupling.

10 Claims, 10 Drawing Sheets



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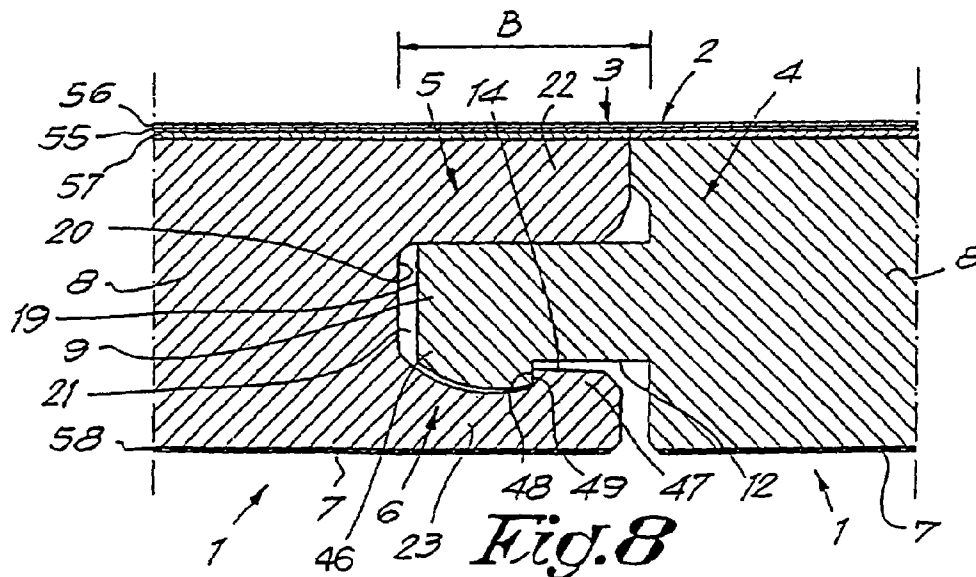
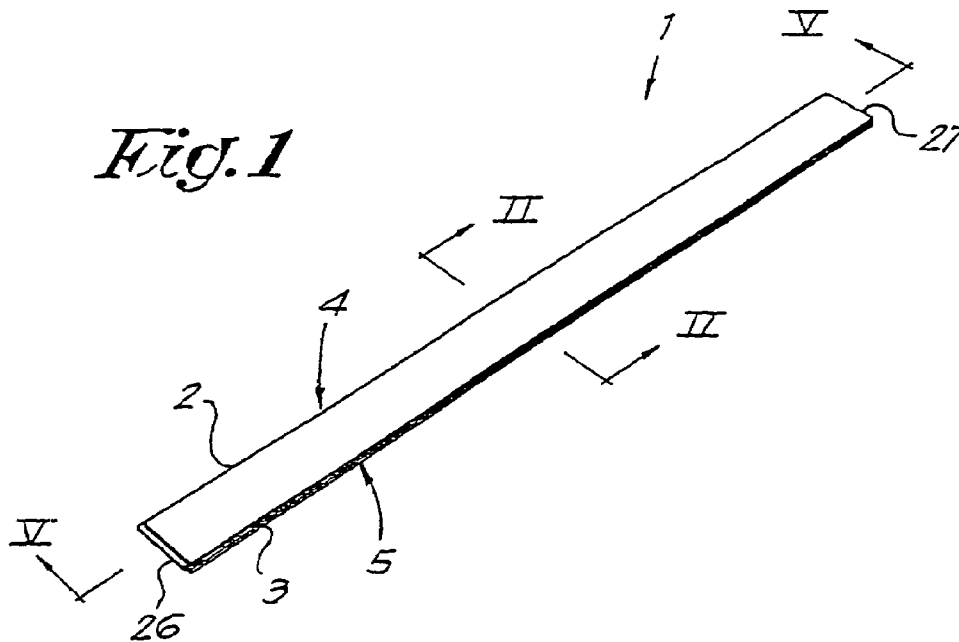
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Fig. 1



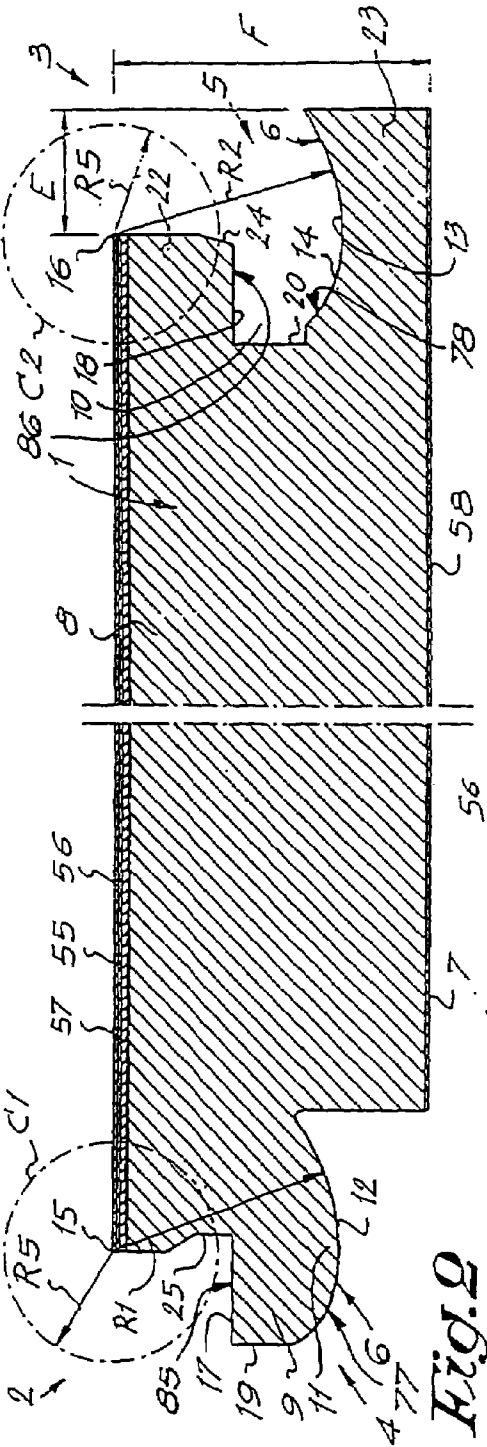


Fig. 2

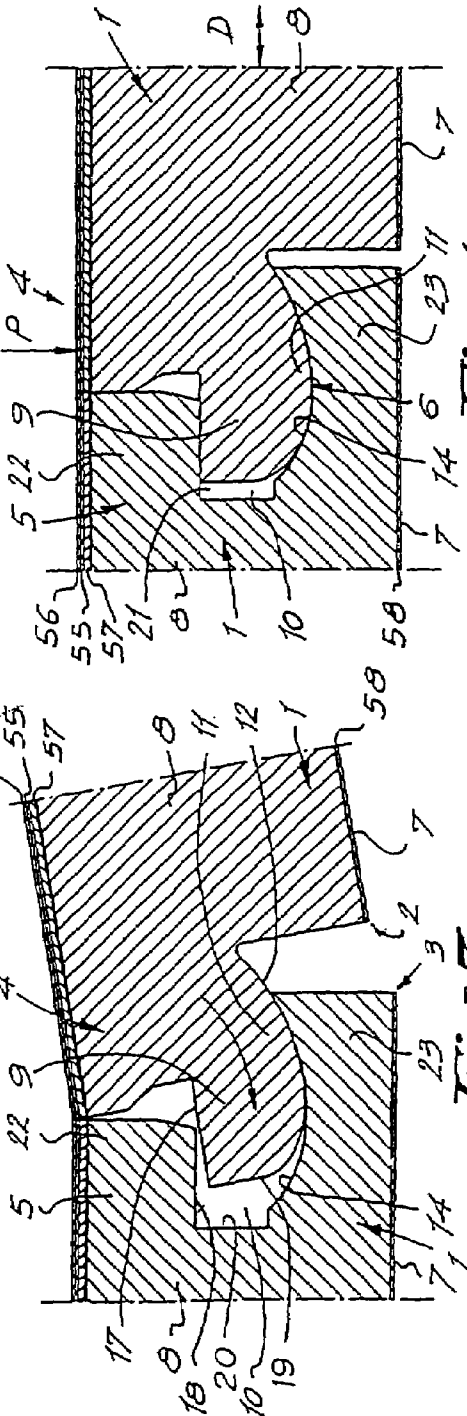


Fig. 3

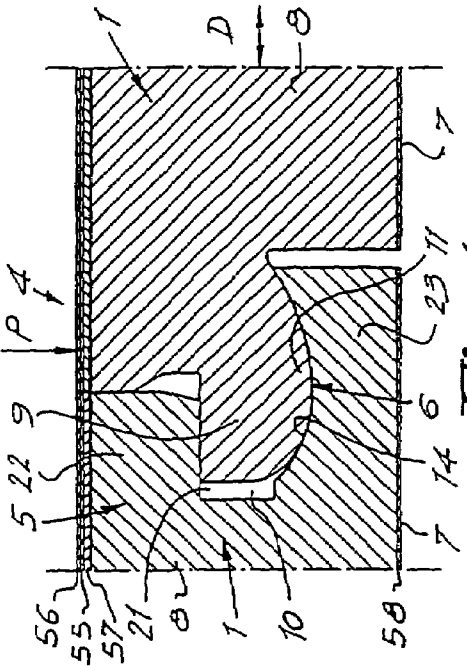
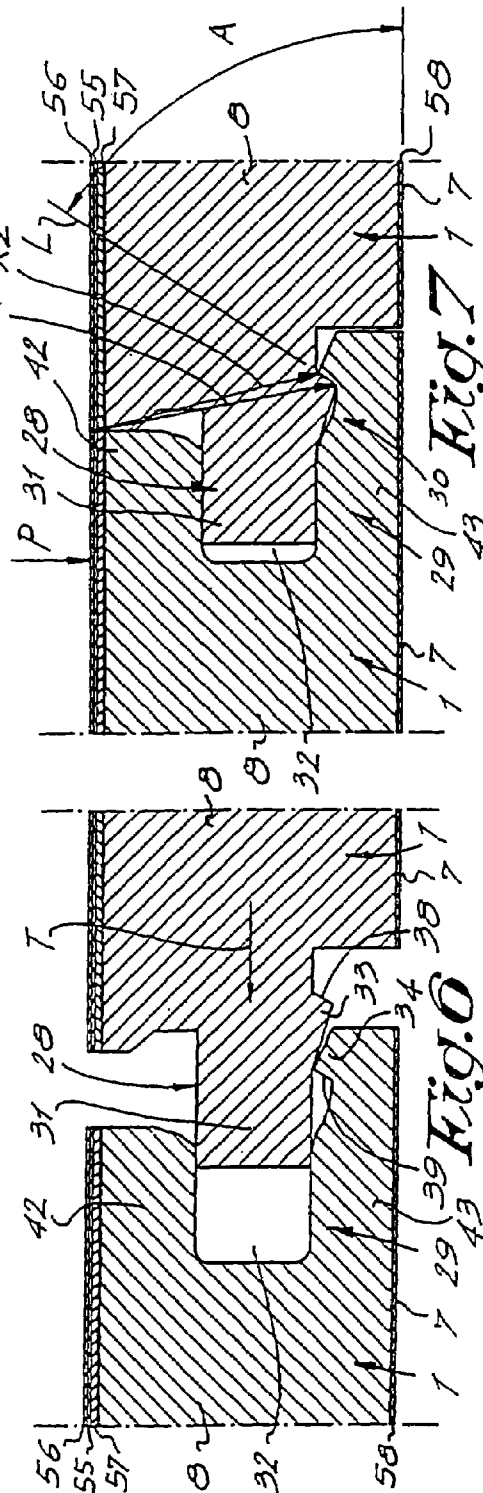
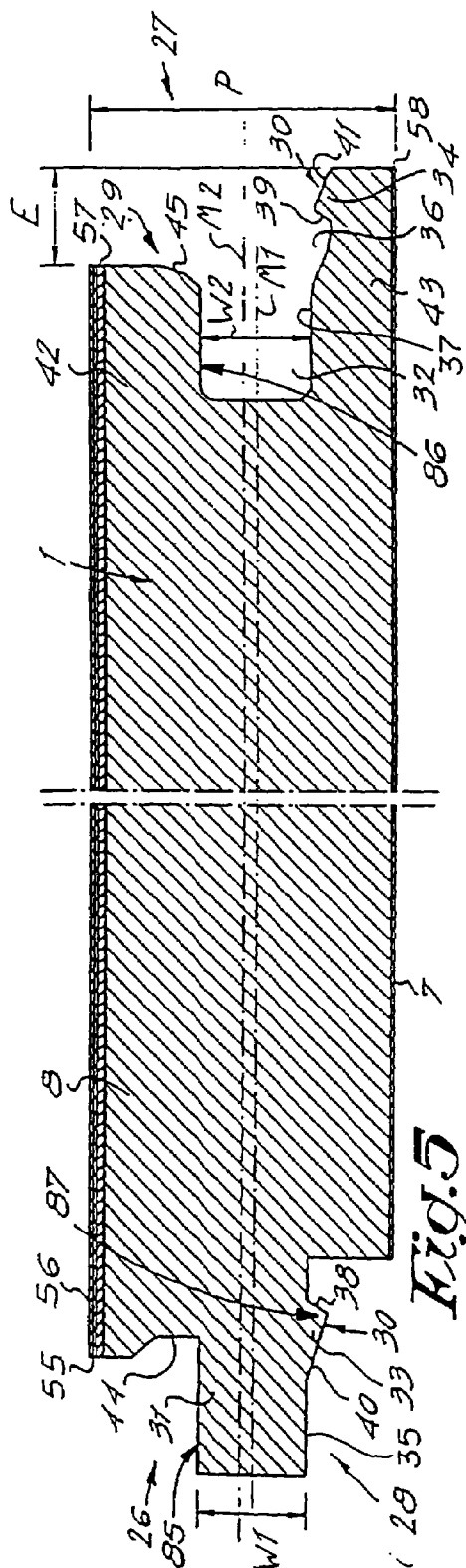


Fig. 4



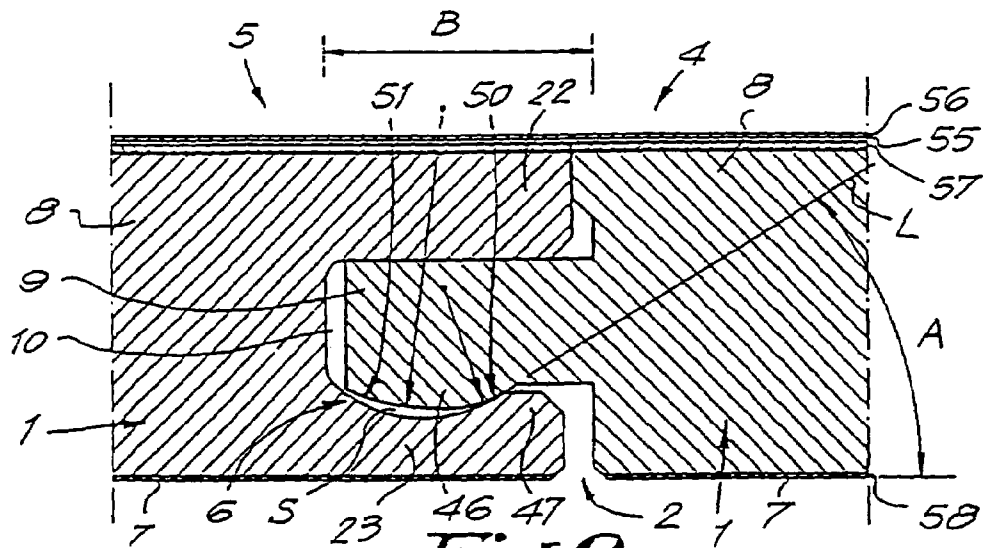


Fig. 9

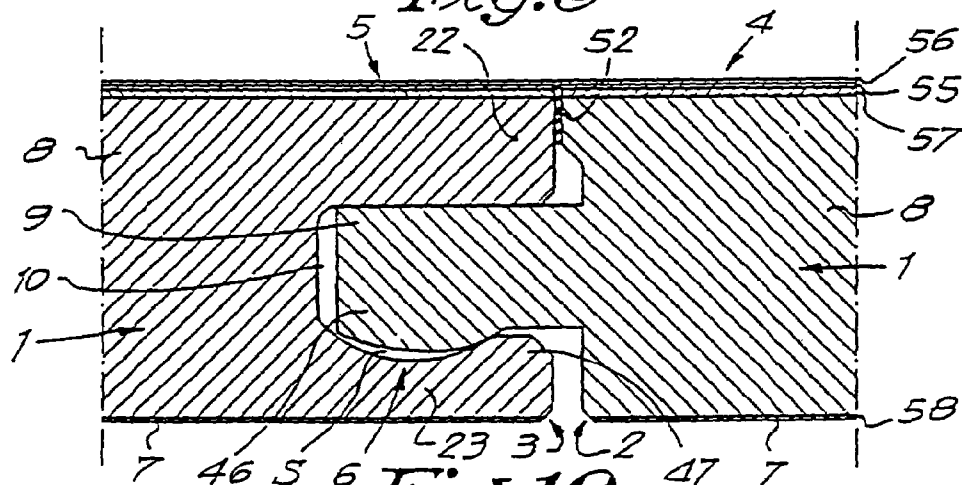


Fig. 10

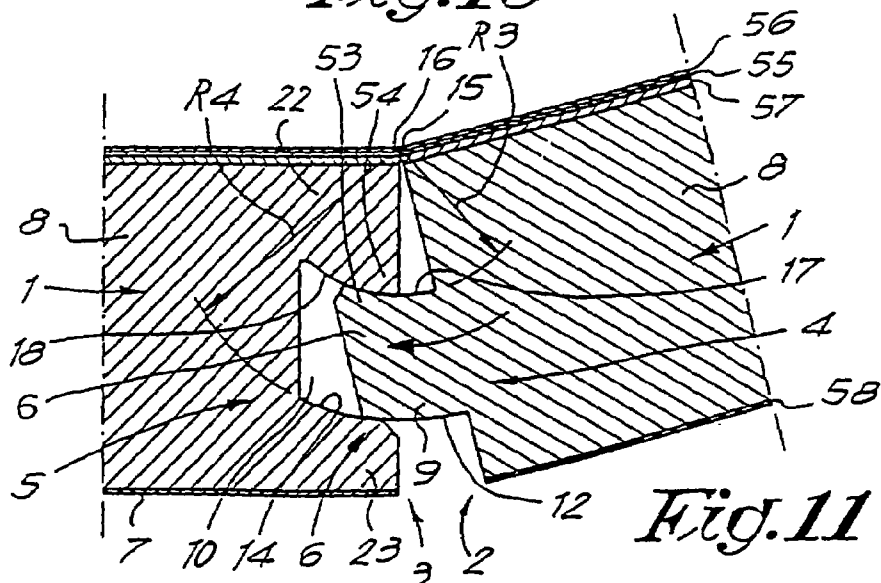


Fig. 11

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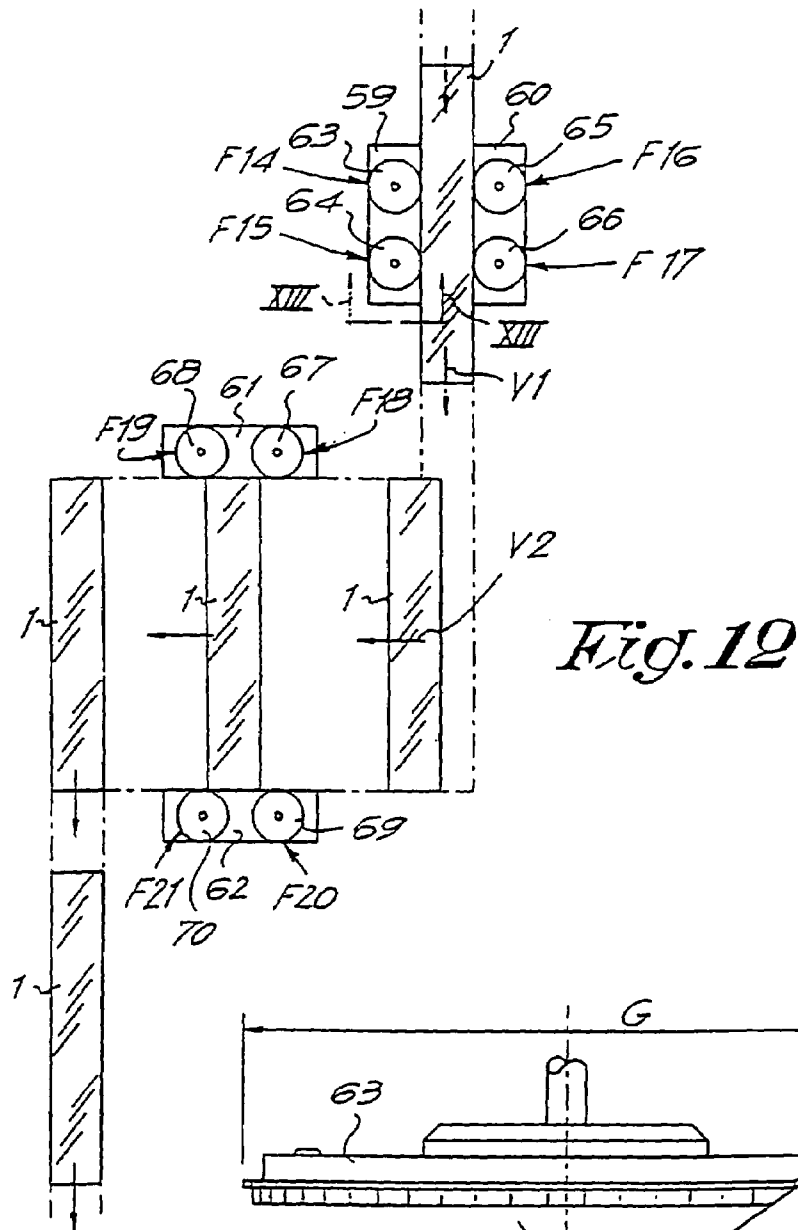


Fig. 12

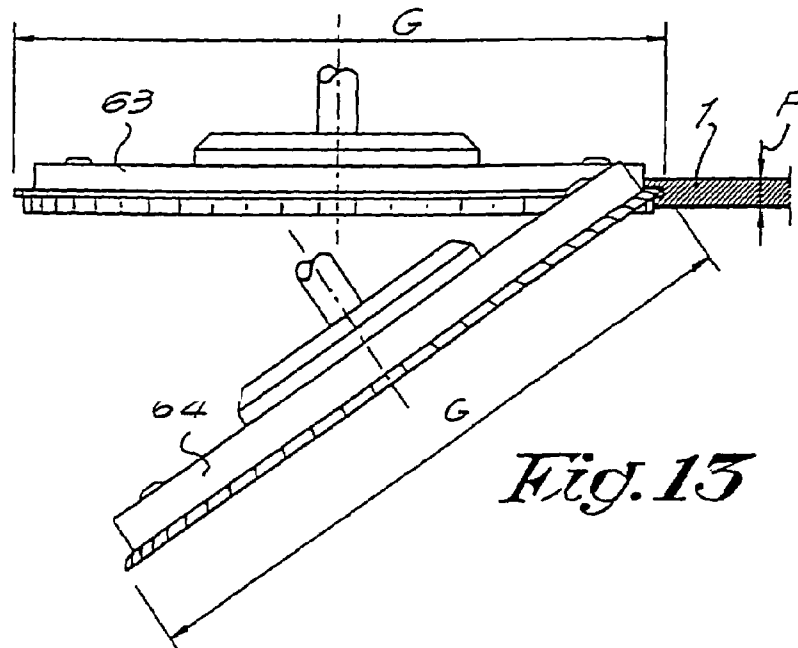


Fig. 13

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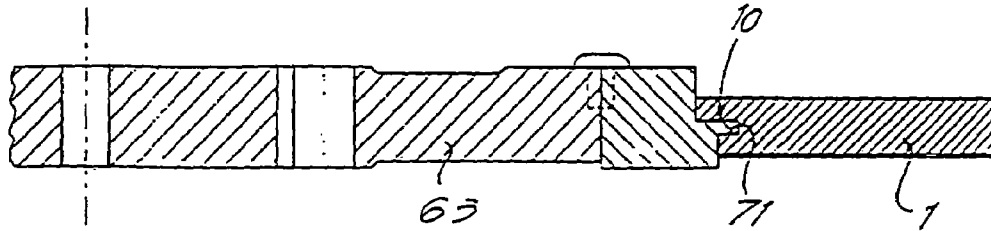


Fig. 14

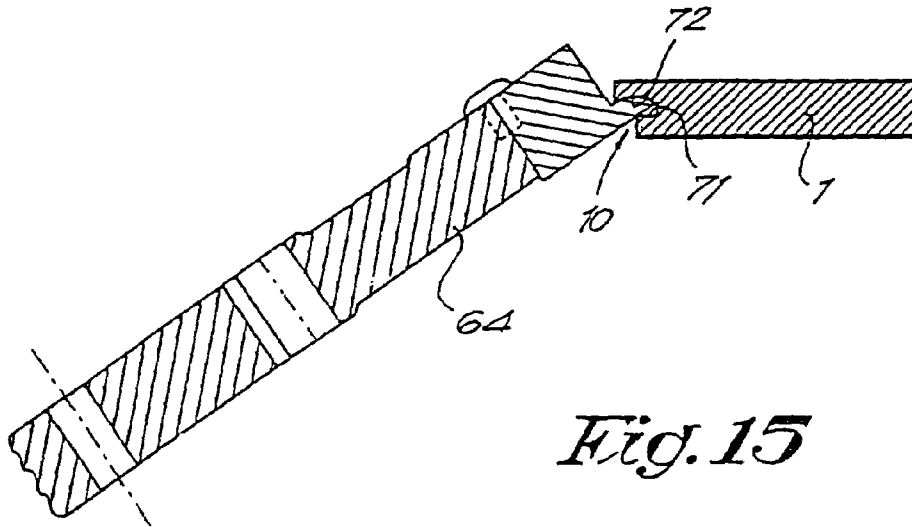


Fig. 15

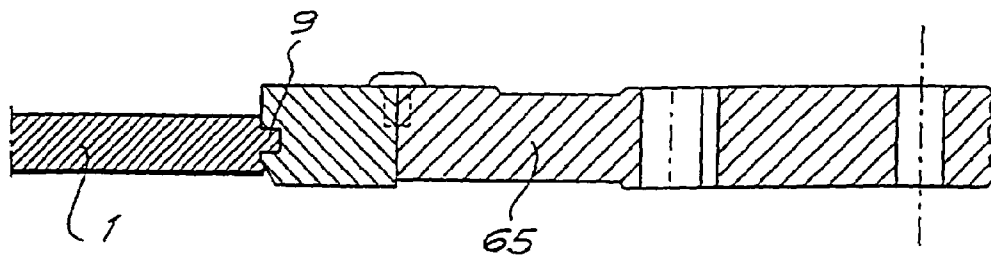


Fig. 16

Fig. 17

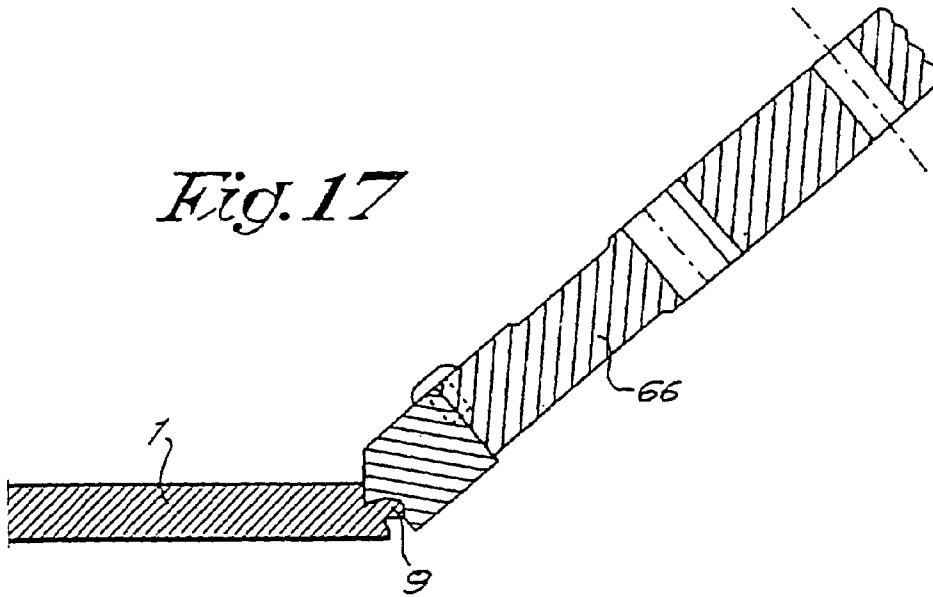


Fig. 18

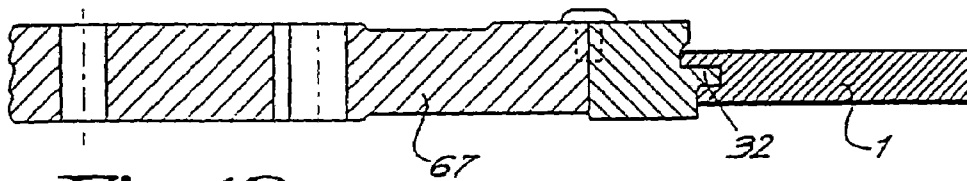
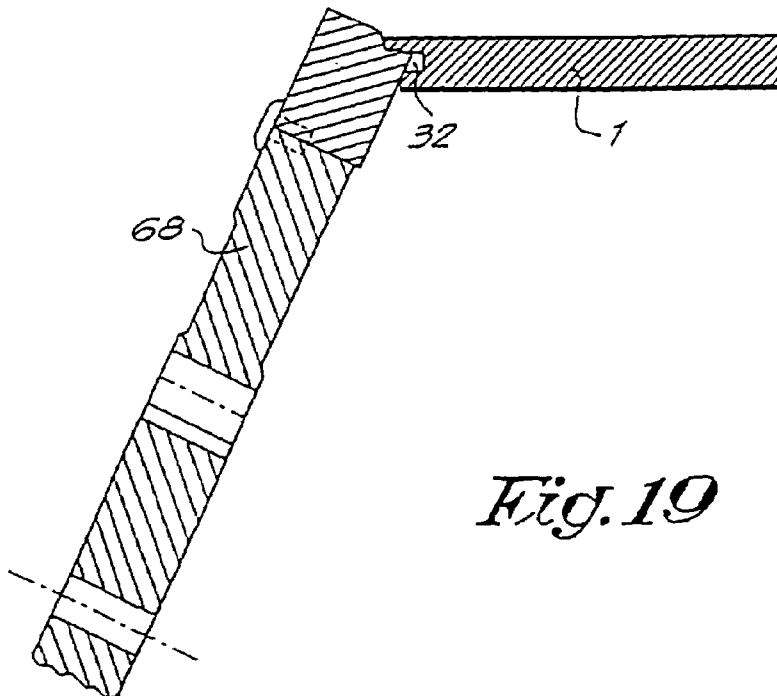


Fig. 19



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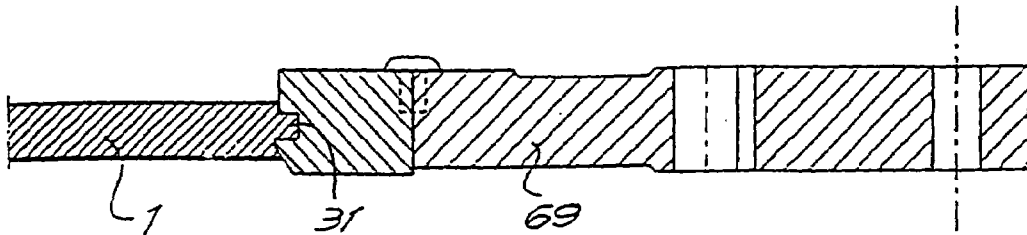


Fig. 20

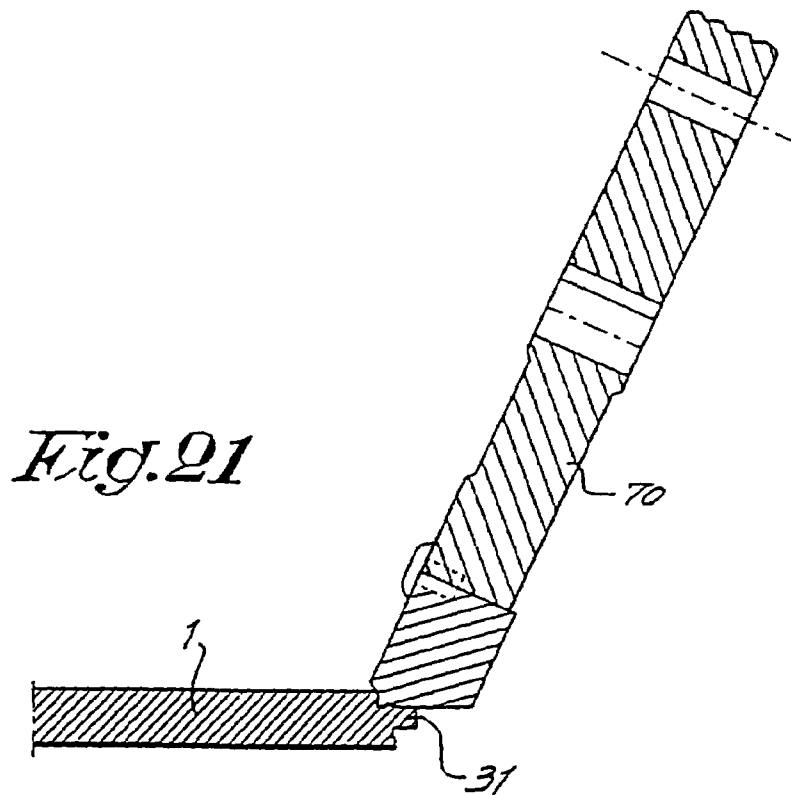
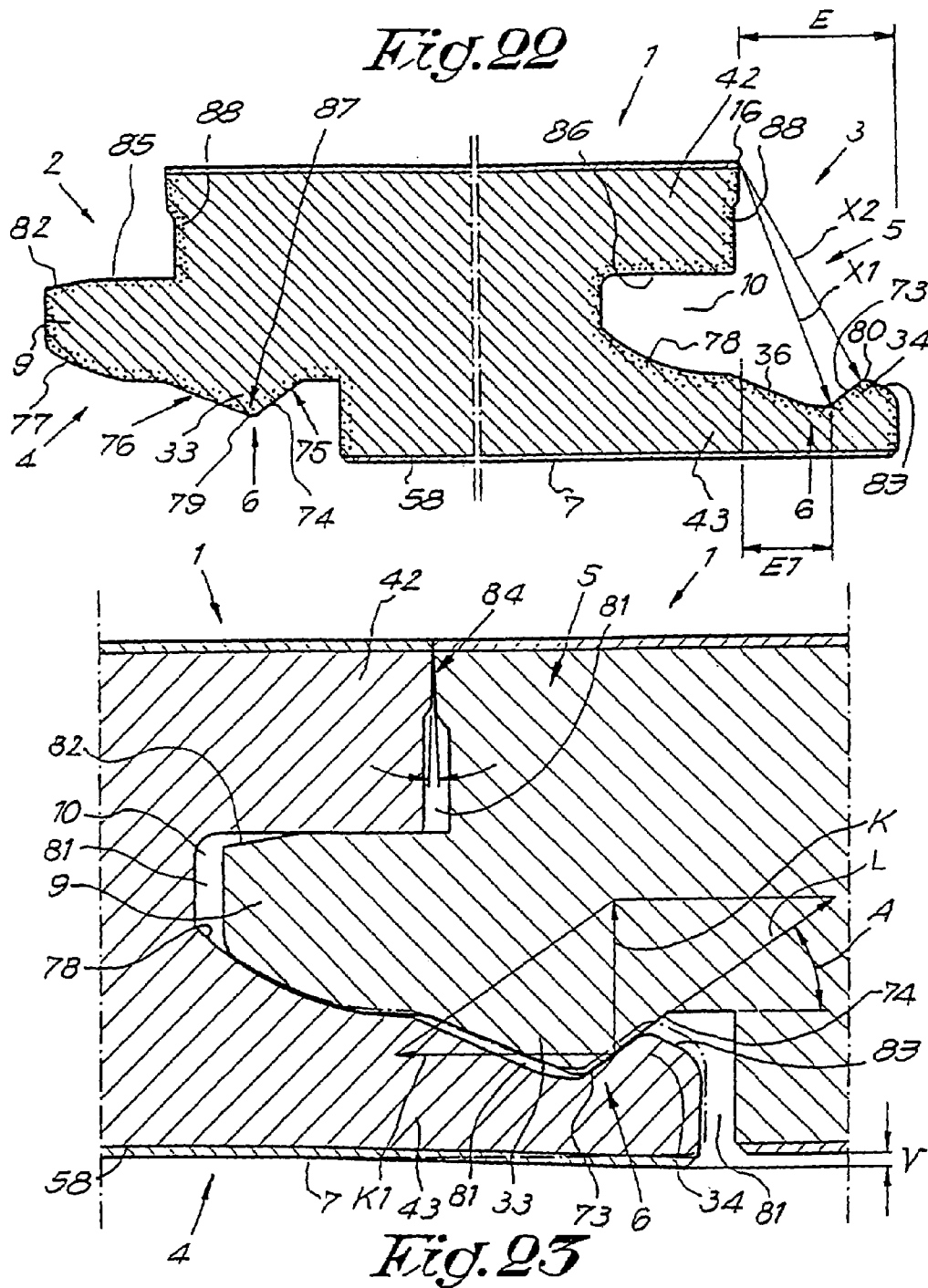
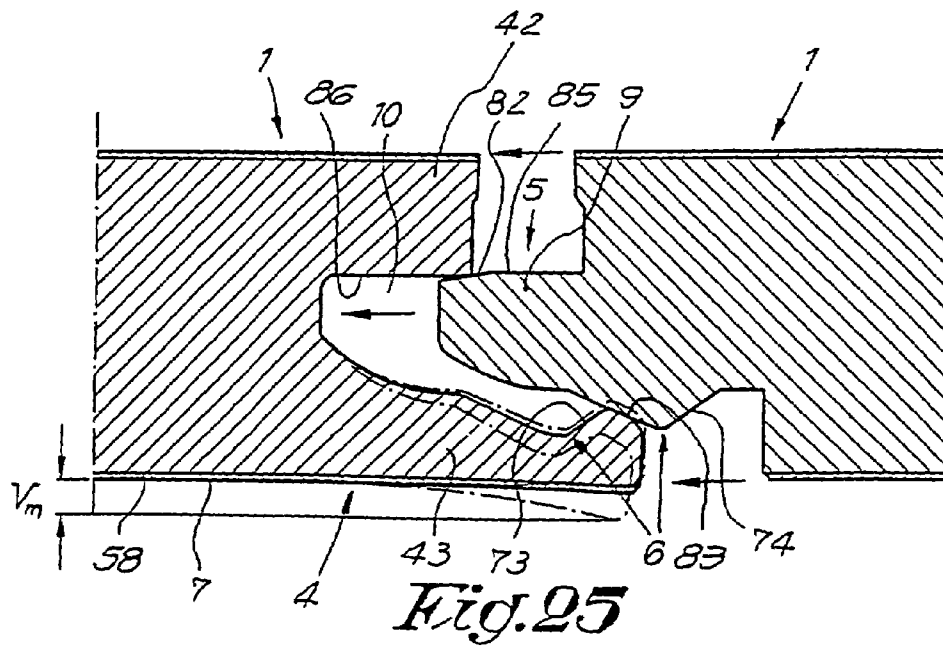
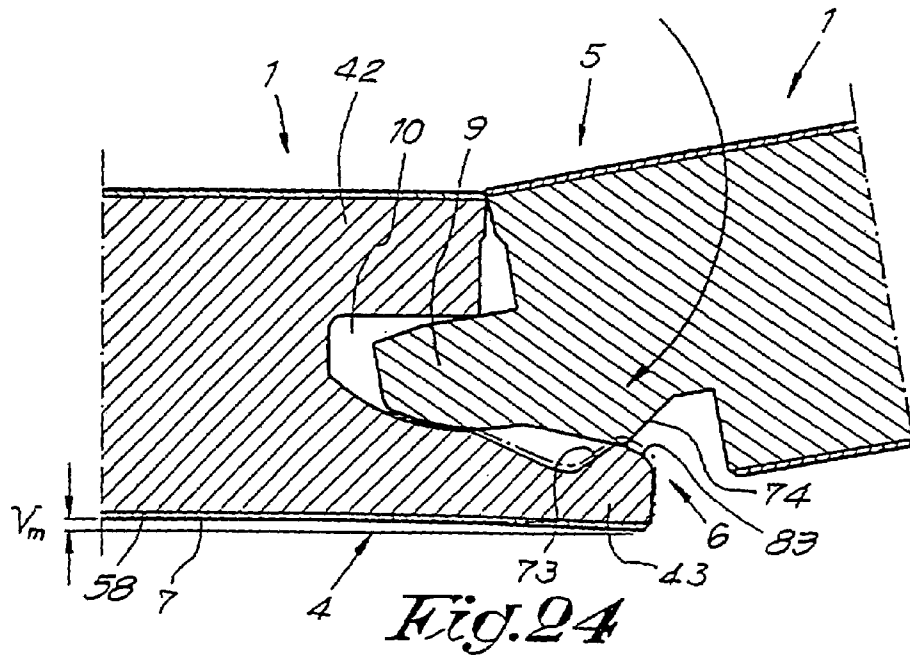


Fig. 21





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FLOOR PANELS WITH EDGE CONNECTORS

RELATED APPLICATION DATA

This application is a continuation of pending application Ser. No. 11/417,189 filed May 4, 2006; which is a continuation of application Ser. No. 10/256,183 filed Sep. 27, 2002, now U.S. Pat. No. 7,040,068; which is a continuation of application Ser. No. 09/471,014, filed Dec. 23, 1999, now U.S. Pat. No. 6,490,836; which is a continuation of application Ser. No. 08/872,044 filed Jun. 10, 1997, now U.S. Pat. No. 6,006,486.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a floor covering made of hard floor panels.

2. Related Technology

In the first instance, the invention is intended for so-called laminated floors, but generally it can also be applied for other kinds of floor covering, consisting of hard floor panels, such as veneer parquet, prefabricated parquet, or other floor panels which can be compared to laminated flooring.

It is known that such floor panels can be applied in various ways.

According to a first possibility, the floor panels are attached at the underlying floor, either by glueing or by nailing them on. This technique has a disadvantage that is rather complicated and that subsequent changes can only be made by breaking out the floor panels.

According to a second possibility, the floor panels are installed loosely onto the subflooring, whereby the floor panels mutually match into each other by means of a tongue and groove coupling, whereby mostly they are glued together in the tongue and groove, too. The floor obtained in this manner, also called a floating parquet flooring, has as an advantage that it is easy to install and that the complete floor surface can move which often is convenient in order to receive possible expansion and shrinkage phenomena.

A disadvantage with a floor covering of the above-mentioned type, above all, if the floor panels are installed loosely onto the subflooring, consists in that during the expansion of the floor and its subsequent shrinkage, the floor panels themselves can drift apart, as a result of which undesired gaps can be formed, for example, if the glue connection breaks.

In order to remedy this disadvantage, techniques have already been through of whereby connection elements made of metal are provided between the single floor panels in order to keep them together. Such connection elements, however, are rather expensive to make and, furthermore, their provision or the installation thereof is a time-consuming occupation.

Examples of embodiments which apply such metal connection elements are described, among others, in the documents WO 94/26999 and WO 93/13280.

Furthermore, couplings are known which allow coupling parts to snap fit into each other, e.g., from the documents WO 94/1628, WO 96/27719 and WO 96/27721. The snapping-together effect obtained with these forms of embodiment, however, does not guarantee a 100-percent optimum counteraction against the development of gaps between the floor panels, more particularly, because in fact well-defined plays have to be provided in order to be sure that the snapping-together is possible.

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From GB 424.057, a coupling for parquetry parts is known which, in consideration of the nature of the coupling, only is appropriate for massive wooden parquetry.

Furthermore, there are also couplings for panels known from the documents GB 2.117.813, GB 2,256.023 and DE 3.544.845. These couplings, however, are not appropriate for connecting floor panels.

BRIEF SUMMARY OF THE INVENTION

The invention aims at an improved floor covering of the aforementioned type, the floor panels of which can be coupled to each other in an optimum manner and/or the floor panels of which can be manufactured in a smooth manner, and whereby preferably one or more of the aforementioned disadvantages are excluded.

The invention also aims at a floor covering which has the advantage that no mistakes during installing, such as gaps and such, can be created.

Furthermore, the invention also aims at a floor covering whereby the subsequent development of gaps is excluded or at least counteracted in an optimum manner, whereby also the possibility of the penetration of dirt and humidity is minimalized.

To this aim, the invention relates to a floor covering, consisting of hard floor panels which, at least at the edges of the two opposite sides, are provided with coupling parts, cooperating which each other, substantially in the form of a tongue and a groove, wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels into a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels. Hereby, these coupling parts are optimized in such a manner that they allow that any form of play is counteracted and preferably is excluded.

By integrated mechanical locking elements is understood that these form a fixed part of the floor panels, either by being connected in a fixed manner to the floor panels, or by being formed in one piece therewith.

In a first important preferred form of embodiment, the coupling parts are provided with locking elements which, in the engaged position of two or more of such floor panels, exert a tension force upon each other which force the floor panels towards each other. As a result of this that not only the formation of gaps counteracted during installation, but also in a later stage the development of gaps, from any causes whatsoever, is counteracted.

According to another characteristic of the intention, the coupling parts, hereby are formed in one piece with the core of the floor panels.

According to a second important preferred embodiment, the aforementioned optimization is achieved in that the floor covering panel possesses the following combination of characteristics: the coupling parts and locking elements are formed in one piece with the core of the floor panels; the coupling parts have such a shape that two subsequent floor panels can be engaged into each other exclusively by snapping together and/or turning, whereby each subsequent floor panel can be inserted laterally into the previous; the coupling parts are interlocked free from play in all directions in a plane extending perpendicular to the aforementioned edges; the possible difference between the upper and lower lip of the lips which border the aforementioned grooves, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than one time the total of the thickness of the panel; the total

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thickness of each related floor panel is larger than or equal to 5 mm; and that the basic material of the floor panels, of which the aforementioned core and locking elements are formed, consists of a ground product which, by means of a binding agent or by means of melting together, is made into a unitary composite, and/or of a product on the basis of synthetic material and/or of a chip board with fine chips.

Due to the fact that the coupling parts provide for an interlocking free from play, as well as due to the fact that these coupling parts are manufactured in one piece, from the basic material of the floor panels, a perfect connection between adjacent floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of characteristics can be combined or not with the aforementioned characteristic that the locking elements exert a tension force upon each other when panels are joined together.

According to a third important preferred embodiment, the characteristics of which may or may not be combined with the characteristics of the embodiments described above, the floor covering is characterized in that the lower lip which limits or defines the lower side of the groove, extends beyond the upper lip in the plane of the panel; the locking elements are formed at least of a contact portion which inwardly slopes downward; and that this portion, at least partially, is located in the portion of the lower lip which extends beyond the upper lip. The advantages of these features will appear from the further description.

According to a preferred form of embodiment, the floor panels are configured as elongated panels and the coupling parts described above are applied along the longitudinal sides of these panels.

According to a particular form of embodiment, coupling parts are provided at the other two sides, too, either of another construction than described above or not.

In the most preferred form of embodiment, for the basic material use shall be made of the aforementioned product, which, as said, is ground and, by means of a binding agent, made into a unitary composite material. More particularly, for the core use shall be made of finely-ground wood which preferably is glued, more particularly, moisture resistant glued. Still more particularly, for the core use shall be made of so-called HDF board (High Density Fibreboard) or MDF board (Medium Density Fibreboard) which is highly compressed ground wood particles (fibers) and binder material. Hereinafter, the wood component of the core material shall be referred to as "wood product".

The fact that the invention is applied to floor panels the basic material of which consists of the material described above, offers the advantage that with the processing of this material, very smooth surfaces are obtained whereby very precise couplings can be realized, which, in first instance, is important in the case of a snap-together connection and/or turning connection free from play. Also, very special forms of coupling parts can be manufactured in a very simple manner because the aforementioned kinds of material can be processed particularly easy.

The surfaces obtained with HDF and MDF also have the advantage that the floor panels mutually can be shifted readily alongside each other in interlocked condition, even when engaged with a tensioning force.

The applicants also discovered that the aforementioned materials, in particular HDF and MDF, show ideal features in order to realize a connection, such as mentioned above, as these material show the right features in respect to elastic deformation in order to, on the one hand, realize a snap-

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together effect, and, on the other hand, receive expansion and shrinkage forces in an elastic manner, whereby it is avoided that the floor panels come unlocked or are damaged in an irreparable manner.

In the case that for the core use is made of a material based on synthetic material, to this end solid synthetic material can be used as well as a mixture of synthetic materials, eventually composed of recycled materials.

The floor covering preferably is formed by joining the floor panels into each other free of glue. Hereby, the connections are of such nature that the floor panels can be disassembled without being damaged, such that, for example, when moving from one residence or location to another, they can be taken along in order to be placed down again. It is, however, clear that a glueing between tongue and groove is not excluded.

The invention, of course, also relates to floor panels which allow the realization of the aforementioned floor covering.

The invention also relates to a method for the manufacturing of the aforementioned floor panels with the advantage that the tongues and/or grooves, including the corresponding locking means, can be provided at the floor panels at high production speeds without problems. More particularly, it aims at a method which allows that the rather complicated forms of the tongue and the groove of the aforementioned floor panels can be formed completely by means of milling cutters, the diameter of which can be chosen independent of the form to be realized, such that the use of small milling cutters, for example finger cutters, with diameters smaller than the depth of the tongue or groove can be excluded.

In accordance with this method the tongue and/or groove is formed by means of a milling process using at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in respect to the related floor panel. During each of the aforementioned milling cycles, preferably substantially the final form of one flank, either of the tongue or of the groove, is formed.

For the aforementioned two milling cycles, thus, milling cutters are used which extend outside the groove, respectively the tongue. More particularly the diameters of these milling cutters shall at least be 5 times and even better 20 times larger than the thickness of the floor panels.

The use of milling cutters having the aforementioned diameters has as an advantage that the normal production speeds can be maintained which are also applied during milling of a classical straight tongue and groove. There is also the advantage obtained that the installation of such milling cutters induce only minor or no additional costs because such milling cutters can be placed directly upon a motor shaft and/or the conventional machines can be used.

BRIEF DESCRIPTION OF THE DRAWINGS

With the intention of better showing the characteristics according to the invention, in the following, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

FIG. 1 represents a floor panel of a floor covering according to the invention;

FIG. 2, on a larger scale, represents a cross-section according to line II-II in FIG. 1;

FIGS. 3 and 4 represent how two floor panels with coupling parts according to FIG. 2 match into each other;

FIG. 5, on a larger scale, represents a cross-section according to line V-V in FIG. 1;

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FIGS. 6 and 7 represent how two floor panels with coupling parts according to FIG. 5 match into each other;

FIGS. 8 to 11 represent a number of variants of coupling parts of floor panels according to the invention;

FIG. 12 schematically represents how the floor parts can be provided with coupling parts;

FIG. 13 represents a cross-section according to line XIII-XIII in FIG. 12;

FIGS. 14 to 21, on a larger scale and in cross-section, represent the penetration of the milling cutters which are indicated in FIG. 12 with arrows F14 to F21;

FIG. 22 represents a floor panel according to the invention;

FIG. 23, on a larger scale, represents the coupling of two floor panels of FIG. 22;

FIGS. 24 and 25 represent two manners of coupling floor panels according to FIG. 22 to each other.

DETAILED DESCRIPTION

The invention relates to a floor covering which is composed of hard floor panels 1, for example, such as a laminated panel as shown in FIG. 1.

These floor panels 1 can be of various shape, for example, rectangular or square, or of any other shape.

In the most preferred form of embodiment, they shall be manufactured in an elongated form, such as shown in FIG. 1, for example, with a length of 1 to 2 meters. The thickness, however, can also vary, but is preferably 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is, at least at the edges of two opposite sides 2-3, provided with coupling parts 4-5 which permit two adjacent identical floor panels 1 to be coupled to each other.

According to the invention, the coupling parts 4-5, as represented in the FIGS. 2 to 4, are provided with integrated mechanical locking parts or locking elements 6 which prevent the drifting or sliding apart of two coupled floor panels 1 in a direction D perpendicular to the respective sides 2-3 and parallel to the underside 7 of the coupled floor panels 1; the coupling parts 4-5 and the locking elements 6 are formed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two subsequent floor panels 1 can be engaged into each other solely by snapping-together and/or turning after the coupling parts are partially engaged, whereby each subsequent floor panel 1 can be laterally inserted into the previous; and the coupling parts 4-5 preferably are interlocked free from play in all directions in a plane which is located perpendicular to the aforementioned edges.

In the case of floor panels 1 with an elongated shape, as represented in FIG. 1, the respective coupling parts 4-5 are located at the longitudinal sides 2-3.

The coupling parts 4-5 can be realized in various forms, although the basic forms thereof will always be formed by a tongue 9 and a groove 10.

In the form of embodiment of FIGS. 2 to 4, the related floor panel 1 is provided with coupling parts 4-5 and locking means or locking elements 6 which allow two floor panels 1 to be mutually engaged by means of a turning movement, without the occurrence of any snap-together effect.

In the represented example, the locking elements 6 consist of a first locking element 11, formed by a protrusion with a bent round shape at the lower side 12 of the tongue 9, and a second locking element 13 (shown in FIG. 2), formed by a recess with a bent hollow or downwardly concave shape in the lower wall 14 of the groove 10.

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The locking elements 11-13 ensure that two floor panels 1 which are coupled to each other can not move laterally in the horizontal plane with respect to each other.

In order to enable two floor panels 1 to be inserted into each other by means of a turning movement, the curvatures preferably are circular. The bottom side 12 of locking means or locking elements 6 has a curvature with a radius R1, the center of which coincides with the respective upper edge 15 of the floor panel 1, whereas the lower wall 14 of the locking part 5 has a curvature with a radius R2 which is equal to the radius R1, but its center coincides with the respective upper edge 16. Radii R1 and R2 may also be applied which are larger or smaller than the distance to the upper edge 15, 16 respectively, and/or which differ from each other in size.

The upper side 17 of the tongue 9 and the upper wall or side 18 of the groove 10 are preferably flat and preferably are located in the horizontal plane.

The inner side 20 of the groove 10 and the front side 19 of the tongue 9 of the two interlocked floor panels 1 preferably do not fit closely against each other, such that an intermediate space 21 is created between them into which possible dust remainders or such can be pushed away by means of the tongue 9.

The tongue 9 and the groove 10 preferably have shapes which are complementary to each other, such that the tongue 9 in the engaged condition of two identical floor panels 1 precisely sits against the upper wall 18 and the lower wall 14 of the groove 10, whereby a pressure P, exerted against the upper lip 22, is received or reacted not only by this lip 22, but by the complete structure, because this pressure can be transmitted through the tongue 9 and the lower lip 23 to cause the panels to be urged towards each other.

It is, however, clear that a number of minor deviations to these complementary forms can occur which, anyhow, have no or almost no effect upon the receipt and transmission of pressure forces. For example, a chamfer 24 on lip 22 and a recess 25 can be provided, as represented in FIGS. 2 to 4, as a result of which the subsequent floor panels 1 can easily be pushed and guided into each other, such that no possible ridges in the subflooring or such render good insertion difficult.

As represented in the FIGS. 5 to 7, the floor panels 1 according to the invention can also, along the sides 26-27 which are at a right angle to the sides 2-3, be provided with coupling parts 28-29 which have locking elements 30, too. The coupling parts 28-29 are preferably also realized in the shape of a tongue 31 and a groove 32. Hereby, the locking elements 30 do not have to be of the same nature as the locking elements 6.

Preferably, at the sides 26-27 locking elements are provided which allow for an engagement and interlocking by means of a lateral translation movement in direction T only, as represented in FIGS. 6 and 7. To this aim, the locking elements 30 consist of a snap-together connection with locking elements 33 and 34 which grip behind each other.

As represented in FIGS. 5 to 7, the locking element 33 preferably consists of a protrusion of the lower side 35 of the tongue 31 which can be located in a recess 36 in a lower lip 43 extending distally from the lower wall 37 of the groove 32. The locking element 34 is formed by the upward directed part or protrusion which defines the distally outer end of recess 36.

In this case, the locking elements 33-34 have contact surfaces 38-39 which are parallel to each other and preferably extend in an inclined manner, according to a direction which simplifies the snapping-together of the panels. The common plane of tangency L which is determined by the

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common tangent at the meeting point or area of surfaces **38-39**, hereby forms an angle **A** sloping inwardly and downwardly from an outer region to an inner region relative to the underside **7**, which angle is smaller than 90° .

The locking elements **33-34** preferably are provided with inclined portions **40** and **41** which, when two floor panels **1** are engaged, cooperate with each other in such a manner that the locking elements **33-34** can easily be pushed over each other until they grip behind each other by means of a snap-together effect (FIGS. **6** and **7**).

The thickness **W1** of the tongue **31** preferably is equal to the width **W2** of the groove **32**, such that compression pressure **P** applied to the upper lip **42** is reacted by the tongue **31** which, in its turn, then is reacted by the lower lip **43**.

Analogous to the chamfer **24** and recess **25**, a recess **44** and a chamfer **45** are provided also at the edges **28-29**.

It is noted that such a snap-together coupling can also be applied at the edges **2-3**. Hereby, this can be a snap-together coupling analogous to these of FIGS. **5** to **7**, but this can also be a snap-together coupling using other forms of coupling configurations, for example, such as represented in FIGS. **8** and **9**. Contrary to the locking elements **33-34** which consist of rather local protrusions, in the forms of embodiment of FIGS. **8** and **9** use is made of locking elements **46-47** which, in comparison to the total width **B** of the coupling, extend over a rather large distance.

In this case, the locking elements **46-47** are also provided at the lower side **12** of the tongue **9** and the lower wall **14** of the groove **10**.

According to FIG. **8**, the locking elements **46-47** have contact surfaces **48-49** which are at an angle with the plane of the floor panel **1**. In this manner, a coupling is obtained which is interlocked in a particularly fixed manner.

As represented in FIG. **9**, the locking elements **46-47** possibly can be configured in such a manner that substantially only a linear contact is obtained, for example, because the contact surfaces directed towards each other are formed with different curvatures.

The surfaces, directed towards each other, of the locking elements **46-47** hereby consist of curved surfaces. The common plane of tangency **L** forms an angle **A** which is smaller than 90° , and more preferably is smaller than 70° .

In this manner, the locking element **46** preferably has two portions with a different curvature, on one hand, a portion **50** with a strong curvature and, on the other hand, a portion **51** with a weak curvature. The portion **50** with the strong curvature provides for the formation of a firm coupling. The portion **51** with the weak curvature facilitates the coupling parts **4-5** to be brought into each other easily. The intermediate space **S** forms a chamber which offers space for dust and the like which, when engaging two floor panels **1**, inevitably infiltrates there.

In the case of a snap-together connection, for example, a connection such as represented in FIGS. **7** to **9**, preferably the tongue **9-31** has a shape that thickens from below, which then can cooperate with a widened portion in the groove **10**.

In FIG. **10**, a variant is represented whereby at least at the level of the upper edges **15-16**, a sealing material **52** is provided, as a result of which a watertight sealing can be assured. This sealing material **52** may consist of a strip or covering which is provided previously at the floor panel **1**, either at one or both upperside edges **15-16**.

In FIG. **11**, a further variant is represented, whereby the locking element **6** is formed by an upward directed portion **53** at the tongue **9**, which as a result of a turning movement of the panel, is brought behind a downward-directed portion

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54 on the upper wall **18**. More particularly, this is obtained by forming the upper side **17** and the upper wall **18** with a curvature **R3**, the center of which is situated at the upperside edges **15-16**, and forming the lower side **12** and the lower wall **14** with a radius **R4**, the center of which is also situated at the upperside edges **15** and **16**, respectively. These radii **R3-R4** can be chosen otherwise, too.

In general, according to the invention, the difference between, on one hand, the radius **R1**, **R3** respectively, and, on the other hand, the radius **R2**, **R4** respectively, preferably should not be larger than **2 mm**.

It is also preferred that the center of these radii be situated inside the circle **C1**, **C2** (see FIG. **2**) respectively, which extends with a radius **R5** of **3 mm** centered at upperside edge **15**, **16** respectively.

Finally is noted that, according to the invention, the lower lip **23-43**, as represented in FIGS. **2** to **7**, can be formed distally longer than the upper lip **22-42**. This has an advantage that the coupling parts **4-5-28-29** can be shaped in an easier manner by means of a milling cutter or the like. Furthermore, this simplifies the engagement of two floor panels **1**, because each subsequent floor panel **1** during installation can be placed upon the protruding lower lip **23-43**, as a result of which the tongue **9-31** and the groove **10-32** automatically are positioned in front of each other.

The embodiments wherein the lower lip **23** is equal to or distally shorter than the upper lip **22**, in their turn, offer the advantage that no protruding lip **23** remains at the extreme edge of the floor which might cause problems in finishing the floor installation.

In order to allow for a smooth assembly, to guarantee the necessary stability and firmness and in order to limit the quantity of material to be cut away, the difference **E** between the distally outer edge of the upper lip **22-42** and the distally outer edge of the lower lip **23-43**, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove **10**, should preferably be kept smaller than one time the total thickness **F** of the floor panel **1**. For stability's sake, normally this total thickness **F** shall never be less than **5 mm**.

The small dimension of the difference **E** offers the advantage that the lower lip need not be strengthened by a reinforcement strip or the like.

According to a particular form of embodiment, the central line **M1** through the tongue **9** and the groove **10** is situated lower than the center line **M2** of the floor panel **1**, such, that the upper lip **22-42** is thicker than the lower lip **23-43**. In first instance, this is essential in this kind of connection, because then it is the lower lip **23-43** which bends, whereby the upper side of the floor panel **1** is kept free of possible deformations.

As explained in the introduction, for the core **8** a material is chosen from the following series:

- a ground product which, by means of a binding agent or by means of melting together is made into a unitary composite material;
- a product based on synthetic material;
- chip board with fine chips.

The invention shows its usefulness, in first instance, preferably with laminated flooring, due to the reasons explained in the introduction.

As represented in the examples of the FIGS. **2** to **11**, such laminated flooring preferably consists of a core **8** made of MDF medium density fiberboard board, HDF high density fiberboard board or similar, whereby at least at the upper side of this core **8** one or more layers of material are provided.

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More particularly, it is preferred that the laminated flooring is provided with a decorative layer **55** and a protective top layer **56**. The decorative layer **55** is a layer, impregnated with resin, for example, made of paper, which can be imprinted with a variety of patterns, such as a wood pattern, a pattern in the form of stone, cork, or similar or even with a fancy pattern. The protective top layer **56** preferably also consists of a layer saturated with resin, for example, melamine resin, which in the final product is transparent.

It is clear that still other layers can be applied, such as an intermediate layer **57** upon which the decorative layer **55** is provided.

Preferably, also a backing layer **58** shall be applied at the underside **7**, forming a counterbalancing element for the top layers and, thus, guaranteeing the stability of the form of the floor panel **1**. This backing layer **58** may consist of a material, for example paper, impregnated with a resin, for example, a melamine resin.

As represented schematically in FIG. **12**, the tongue **9** and the groove **10**, and preferably also the tongue **31** and the groove **32** are formed by means of a milling process. In the case that a profile has to be applied on all four sides, the floor panels **1** preferably shall be displaced by means of two sequential perpendicular movements **V1** and **V2**, whereby during the first movement profiles at two opposite edges are provided, in this case the longitudinal edges, by means of milling devices **59-60**, whereas during the second movement profiles are provided at the other edges, in this case the small edges, by means of milling devices **61-62**. During these processing, the floor panels **1** preferably are put with their decorative layer directed downward.

According to an important characteristic of the invention, each respective tongue **9-31** and groove **10-32** are formed by means of a milling process with at least two sequential milling cycles or passes by means of milling cutters which are positioned at different angles in reference to the related floor panel **1**.

This is illustrated in FIGS. **13**, **14** and **15**, wherein it is represented how a groove **10** is realized by means of two milling cycles by means of two milling cutters **63** and **64**. FIGS. **16** and **17** represent how the tongue **9** is shaped by means of milling cutters **65** and **66**.

The FIGS. **18-19** and **20-21** represent similar views showing how the groove **32** and the tongue **31** are shaped by means of milling cutters **67-68** and **69-70**, positioned at an angle.

During each of the aforementioned milling passes, substantially the final shape of one flank is fully realized. For example, the milling cutter **63** of FIG. **14** determines the final shape of the lower flank **71** of the groove **10**, whereas the milling cutter **64** determines the final shape of the upper flank **72**.

As mentioned in the introduction, preferably milling cutters **63** to **72** shall be used, having diameters **G** which are at least 5 times, and even better at least 20 times larger than the thickness **F** of the floor panels **1**.

Apart of the mentioned milling cutters, preferably still other milling cutters are applied, for example, in order to remove a part of the material to be removed during a first premachining cycle.

In the FIGS. **22** to **25**, a particularly preferred form of embodiment of a floor panel **1** according to the invention is represented. Hereby, the parts which correspond with the previous embodiments are indicated with corresponding references.

An important characteristic herein consists in that the coupling parts **4-5** are provided with locking elements **6**

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which, in engaged condition with the panels in a common plane, exert a tension force upon each other, as a result of which the engaged floor panels **1** are forced towards each other in compression. As represented, this is realized preferably by providing the coupling parts with an elastically yieldable or bendable portion, in this case the lower lip **43**, which, in engaged condition, is at least partially bent and in this way creates a tension force which results in the engaged floor panels **1** being forced towards each other. The resultant bending **V**, as well as the tension force **K**, are indicated in the enlargement view of FIG. **23**.

In order to obtain the tension force **K** pressing together the engaged floor panels **1**, the bendable portion, in this case the lip **43**, preferably is provided, as represented, with an inwardly and downwardly inclined contact surface **73** which preferably can cooperate with a corresponding contact surface **74** on tongue **9**. These contact surfaces **73-74** are similar to the aforementioned contact surfaces **39-38** and also similar to the inclined portions of the lower lip of FIGS. **2** to **4**.

In the FIGS. **2** and **5**, the portions form complementary matching shapes; it is, however, clear that, by a modification, also a tension effect similar to that shown in FIG. **23** can be realized.

Due to, on one hand, the contact along the angle **A**, and, on the other hand, the fact that a tension force **K** is created, a compression force component **K1** is produced, as a result of which the floor panels **1** are drawn against each other in compression.

Preferably, the angle **A** of the mutual plane of tangency of contact surfaces **73-74** relative to the horizontal plane is situated between 30 and 70 degrees. In the case that use is made of the embodiment whereby a tension force **K** is realized, an angle **A** of 30 to 70 degrees is ideal in order, on one hand, to effect an optimum pressing-together of the floor panels **1** and, on the other hand, to ensure that the floor panels **1** can easily be engaged and respectively disassembled.

Although the pressing or compression force component **K1** preferably is delivered by the aforementioned lip **43**, the invention does not exclude other forms of locking elements or structures whereby this force is delivered by other bendable portions.

It is noted that the bending **V** is relatively small, for example, several hundredths up to several tenths of a millimeter, and does not have an influence upon the placement of the floor-covering. Furthermore it should be noted that such floor covering generally is placed upon an underlayer (not shown) which is elastically compressible, as a result of which the bending **V** of the lip **43** only produces local bending of the underlayer.

Due to the fact that the lip **43** is bent apart and that it remains somewhat bent apart in engaged position, the additional advantage is obtained that, when exerting a pressure upon the floor covering, for example, when placing an object thereupon, the pressing-together compressive force is enhanced and, thus, the development of gaps is counteracted even more.

It is noted that the inventors have found that, contrary to all expectations, an ideal tension force can be realized by manufacturing the coupling parts **4-5**, including the locking elements **33-34**, and preferably the complete core **8**, of HDF board or MDF board, although these material normally only allow a minor elastic deformation.

HDF and MDF also offer the advantage that smooth surfaces are obtained, as a result of which the locking elements can be moved easily over each other.

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According to a variant of the invention, the tension force can also be supplied by means of an elastic compression of the material of the coupling parts themselves, to which end these coupling parts, and preferably the complete core 8, would be manufactured using an elastically compressible material.

A further particular characteristic of the embodiment of FIGS. 22 to 25 consists in that the floor panels 1 can be selectively engaged by means of a turning movement, as represented in FIG. 24, as well as by means of laterally shifting them towards each other in substantially a common plane, as represented in FIG. 25, preferably in such a manner that, during the engagement by means of the turning movement with the coupling parts partially engaged, a maximum bending V_m results in the coupling parts, more particularly in the lip 43, which bending V_m is less pronounced, if not nonexistent, as in the FIGS. 2 to 4, in comparison to the bending V_m which results when the floor panels 1 are engaged by means of shifting them towards each other, as in FIG. 15.

The advantage of this consists in that the floor panels 1 can be engaged easily by means of a turning movement, without necessitating use of a tool therefore, whereas it still remains possible to engage the floor panels also by means of shifting them laterally. This latter is useful, in first instance, when the last panel has to be placed partially under a door frame or similar situation. In this case, the floor panel 1 can be pushed under the door frame with the side which does not have to be engaged and subsequently, possibly by means of tools, can be snapped into the adjacent floor panel by lateral sliding together.

It is noted that the shapes of the coupling parts 4-5 shown in FIGS. 22 to 25 can also be used for the coupling parts 28-29 of the short sides of the panels.

According to the invention, in the case that the four sides 2-3-26-27 are provided with coupling parts 4-5-28-29, these coupling parts can be formed in such a manner that in one direction a firmer engagement than in the other direction is effected. In the case of elongated floor panels 1, for example, such as represented in FIG. 1, the locking at the small sides 26-27 preferably shall be more pronounced than at the longitudinal sides 2-3. The length of the parts at the small sides, namely, is smaller and, in principle, less firm. This is compensated for by providing a more pronounced locking.

This difference in engagement can be obtained by shaping the contact surfaces 73-74 with different angles.

Preferably, the aforementioned protrusion, more particularly the locking element 33, is bounded by at least two portions 75-76 (shown in FIG. 22), respectively a portion 75 with a strong (steep) inclination which provides for the locking, and a portion 76 with a weaker (less inclined) inclination which renders the engagement or guidance of the coupling parts easier. In the embodiment of FIGS. 22 to 25, these portions 75-76 are formed by straight planes, but, as already described with reference to FIG. 9, use can also be made of curved portions 50-51. In FIG. 5, these are the contact surface 38 and the inclined portion 40.

In the preferred form of the invention, the floor panels 1 comprise coupling parts 4-5 and/or 28-29 exhibiting one of the following or the combination of two or more of the following features:

a curvature 77 (shown in FIG. 22) at the lower side of the tongue 9 and/or a curvature 78 at the lower lip 43 which form a guidance when turning two floor panels 1 into each other, with the advantage that the floor panels 1 can be engaged into each other easily during installation;

roundings 79-80 at the edges of the locking elements 33-34, with the advantages that the locking elements can easily shift over each other during their engage-

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ment, or during disassembly of the floor panels 1 and that the locking elements will not be damaged, for example, crumble away at their edges, even if the floor panels are engaged and disassembled;

dust chambers 81, or spaces 21 as in FIG. 4, between all sides, directed laterally towards each other, of the engaged floor panels 1, with the advantage that inclusions which get between the floor panels 1 during the engagement do not exert an adverse influence upon good engagement;

a shaping of the tongue 9 which is such, for example, by the presence of a chamfer 82, that the upper side of the tongue 9 becomes situated from the first joining together or substantial contact of the panels, under the lower side of the upper lip 42 when the floor panels 1 are pushed towards each other in substantially the same plane, as indicated in FIG. 25, with the advantage that the front extremity or end of the tongue 9 does not press against the front side of the upper lip 42 or the front edge of the bottom lip 43 when the floor panels are pushed towards each other in the same plane;

a ramp surface 83, hereinbefore also called inclined portion 41, formed at the distally outer end of the lower lip 43, with the advantage that the locking elements 33-34 shift smoothly over each other and that the lower lip 43 is bent uniformly;

in the engagement direction only one important contact point which is formed by a section 84 at the location of the upperside edges of the floor panels 1, with the advantage that the aforementioned tension force is optimally transferred to the upper side of the floor panels 1 and that the development of openings between the floor panels 1 is counteracted;

contact surfaces 85-86, more particularly abutment surfaces, formed by the upper side of the tongue 9 and the upper side of the groove 10 which, over the largest portion of their length, are flat and run parallel to the plane which is defined by the floor panels 1, as well as contact surfaces cooperating with each other, formed by curvatures 77-78, with the advantage that no mutual displacement in height between two engaged floor panels 1 is possible, even if the insertion depth of the tongue 9 into the groove 10 should vary due to various causes; in other words, no height differences may occur between the adjacent floor panels.

In the embodiment of FIGS. 22 to 25, all these characteristics are combined; it is, however, clear that, as becomes evident from FIGS. 2 to 11, these features can also be provided separately or in a limited combination with one another.

As becomes evident from FIGS. 5 to 7 and 22 to 25, an important characteristic of the preferred embodiment of the invention consists in that the cooperative locking element 6, in other words, the portion providing for the snap-together and engagement effect, are situated in that portion of the lower lip 23-43 which extends beyond the distal edge of the upper lip 22-42, more particularly, the lowermost point 87 of the locking part 33 is situated under the top layer of the floor panel 1. For clarity's sake, this top layer is indicated in the FIGS. 22-25 only as a single layer.

It should be noted that the combination of features, the lower lip 23-43 extending further than the upper lip 22-42; the locking elements 6 being formed at least by means of a contact surface portion which inwardly slopes downward, and wherein this portion, at least partially, is located in the portion of the lower lip 23-43 which extends distally beyond the upper lip 22-42, is particularly advantageous, among others, in comparison with the couplings for floor panels described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The sloping contact

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surface portion offers the advantage that the floor panels **1** can be disassembled again. The fact that this sloping portion is situated in the extended portion of the lower lip **23-43** adds the advantage that no deformations can occur during coupling which manifest themselves up to the top layer.

According to a preferred characteristic of the invention, the aforementioned portion, i.e. the contact surface **39** or **73**, preferably extends in such a manner that the distance between the upper edge **16** of the panel to the contact surface **39, 73** diminishes between the proximal and distal ends of the sloping contact surface **39, 73**, in other words, such that, as represented in FIG. **22**, the distance **X2** is smaller than the distance **X1**. This is also the case in FIG. **7**.

Still preferably, this portion only starts at a clear distance **E1** from the outer edge of upper lip **42**.

It is obvious that the coupling parts **22** to **25** can also be shaped by means of said milling process.

According to a particular characteristic of the invention, the floor panels **1** are treated at their sides **2-3** and/or **26-27** with a surface densifying agent, more particularly a surface hardening agent, which preferably is chosen from the following series of products: impregnation agents, pore-sealing agents, lacquers, resins, oils, paraffins and the like.

In FIG. **22**, such impregnation **88** is represented schematically. This treatment can be performed over the complete surface of the sides **2-3** and/or **26-27** or only over specific portions hereof, for example exclusively on the surfaces of the tongue **9** and the groove **10**.

The treatment with a surface densifying agent offers, in combination with the snap-together effect, the advantage that in various aspects better coupling characteristics are obtained. As a result of this, the coupling parts **4-5** and/or **28-29** better keep their shape and strength, even if the floor panels **1** are engaged and disassembled repeatedly. In particular, if the core **8** is made of HDF, MDF or similar materials, by means of this treatment a better quality of surface condition is obtained, such that no abrasion of material occurs during engaging, or during disassembling.

This treatment also offers the advantage that, at least in the case of a surface hardening, the aforementioned elastic tensioning effect is enhanced.

The present invention is in no way limited to the forms of embodiment described by way of example and represented in the figures, however, such floor covering and the pertaining floor panels **1** can be embodied in various forms and dimensions without departing from the scope of the invention.

For example, the various characteristics which are described by means of the represented embodiments or examples may be selectively combined with each other.

Furthermore, all embodiments of coupling elements described before can be applied at the longer side as well as at the shorter side of a panel.

The invention claimed is:

1. A floor panel, for forming a floor covering, said floor panel having a limited panel thickness, which thickness is comprised in the range of 5 to 15 mm; said floor panel further being of the type comprising a core material selected from the group consisting of MDF and HDF;
- said floor panel at least at the edges of two opposite sides being provided with coupling parts substantially in the form of a tongue and a groove, said groove being bordered by an upper lip and a lower lip, and wherein the coupling parts are arranged so as to enable two of such panels to be coupled to each other;
- wherein said lower lip extends beyond said upper lip, so that the lower lip comprises a portion which is located underneath the upper lip and a portion which extends beyond the upper lip;

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wherein the coupling parts are provided with integrated mechanical locking elements which prevent the drifting apart of two coupled floor panels in a direction perpendicular to the related edges and parallel to the underside of the coupled floor panels;

wherein said locking elements comprise a recess in said lower lip and a protrusion at the lower side of said tongue, such that in coupled condition of two of such panels the protrusion of one of said panels cooperates with the recess of the other panel;

wherein said coupling parts and said locking elements are formed in one piece from said core material selected from the group consisting of MDF and HDF;

wherein said recess is partially located in the portion of the lower lip which is located underneath the upper lip and partially in the portion of this lower lip which extends beyond the upper lip; and

wherein in coupled condition of two of such panels they define a vertical plane where the panels with their upper sides fit against each other, and wherein the upper side of the tongue and the lower side of the upper lip are provided with corresponding flat contact surfaces, which in coupled condition of two of such panels cooperate with each other, wherein the contact defined by said cooperating flat surfaces ends at a location laterally offset from said vertical plane in a direction towards a deepest point of the groove.

2. The floor panel of claim **1**, wherein said floor panel is a laminated floor panel of the type comprising a resin impregnated imprinted decor layer.

3. The floor panel of claim **1**, wherein the possible difference in length with which the lower lip extends beyond the upper lip, measured in the plane of the floor panel, is smaller than one time the thickness of the floor panel and thus always smaller than 15 mm.

4. The floor panel of claim **1** or **3**, wherein said locking elements comprise contact surfaces acting as horizontally active locking surfaces, respectively located at said tongue and said groove, which upon coupling of two such panels cooperate with each other and wherein the locking surface provided at the groove is located in the portion of said lower lip which extends beyond said upper lip.

5. The floor panel of claim **1**, wherein the coupling parts and locking elements enable coupling two of such panels in a manner free from play.

6. The floor panel of claim **1**, wherein the floor panel comprises a monolithic core of said MDF or HDF.

7. The floor panel of claim **1**, wherein at the entrance of the groove the upper lip is provided with a chamfer.

8. The floor panel of claim **1**, wherein the recess has an inclined proximal side, said side extending upwards from the bottom of the recess towards the inner side of the panel, said inclined proximal side in the proximal direction being contiguously followed by a bottom portion of the actual groove, which is substantially horizontal or at least generally less inclined than said proximal side of the recess.

9. The floor panel of claim **1**, wherein the lower side of the tongue is provided with a curvature.

10. The floor panel of claim **1**, wherein said coupling parts are configured so as to enable two of such panels at their respective edges to be coupled together at least by turning one panel into the other.

* * * * *

EXHIBIT I

(12) **United States Patent**
Thiers

(10) **Patent No.:** **US 6,786,019 B2**
(45) **Date of Patent:** **Sep. 7, 2004**

(54) **FLOOR COVERING**

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(*) **Notice:** Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

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(52) **U.S. Cl.** **52/589.1; 52/586.1; 52/590.2;**
52/592.1

(58) **Field of Search** 52/578, 589.1,
52/592.1, 570, 571, 572, 590.2, 586.1,
592.3, 591.1, 590.1

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Primary Examiner—Carl D. Friedman

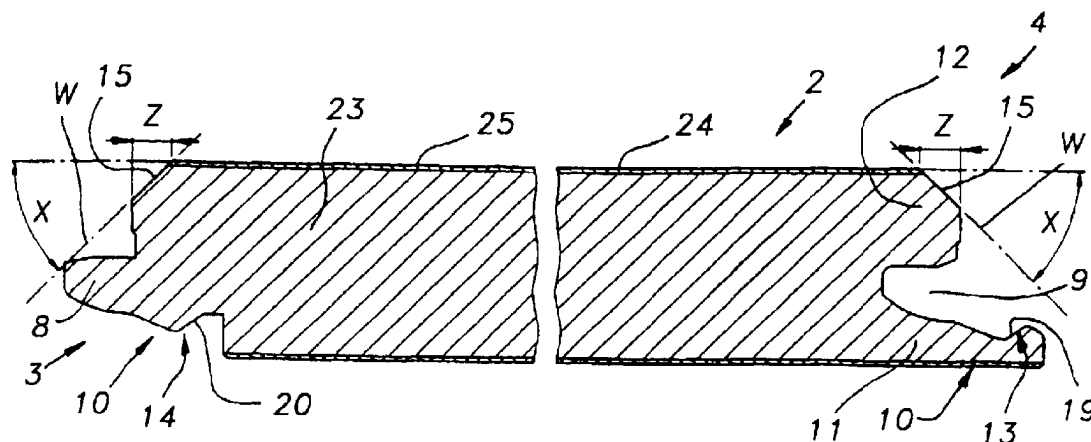
Assistant Examiner—Kevin McDermott

(74) *Attorney, Agent, or Firm*—Becon & Thomas, PLLC

(57) **ABSTRACT**

Floor covering hard panels having at least on two opposite edges, coupling elements made in one piece with the panels, so that several ones of such panels can be mutually coupled, whereby these coupling elements provide for an interlocking in a direction perpendicular to the plane of the panels, as well as in a direction perpendicular to the edges and parallel to the plane of the panels, and whereby these coupling elements are made such that the panels can be rotated into and/or out of one another at least along the above-mentioned edges. The panels are provided, at least on the above-mentioned edges, near the top side, with a part from which has been removed an amount of material such as by a bevel.

18 Claims, 4 Drawing Sheets



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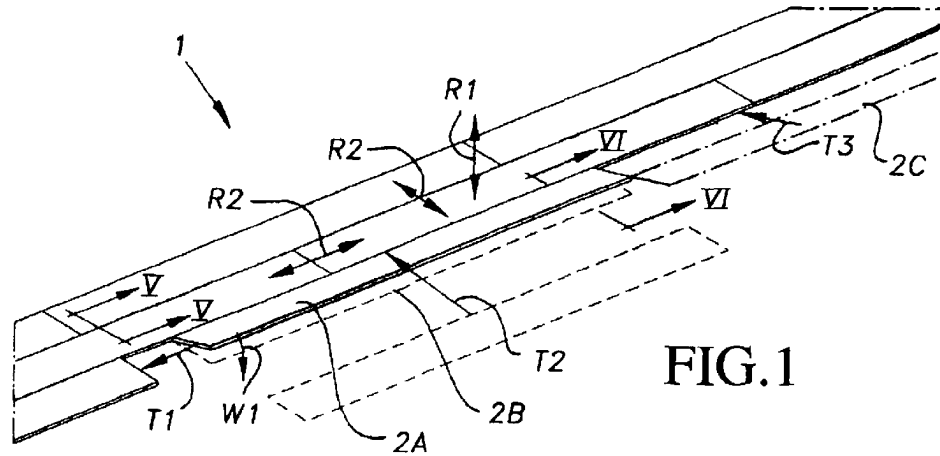


FIG. 1

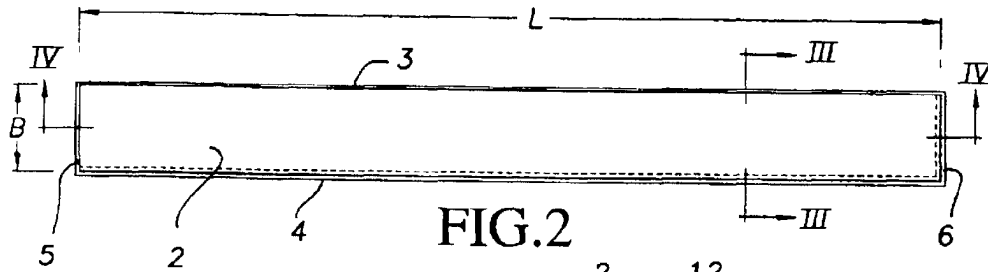


FIG. 2

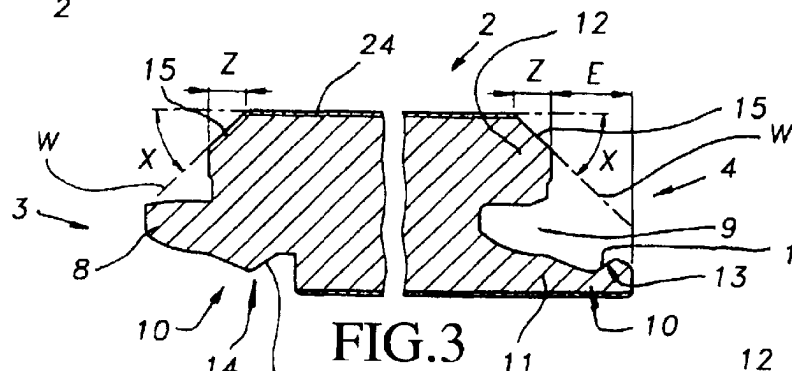


FIG. 3

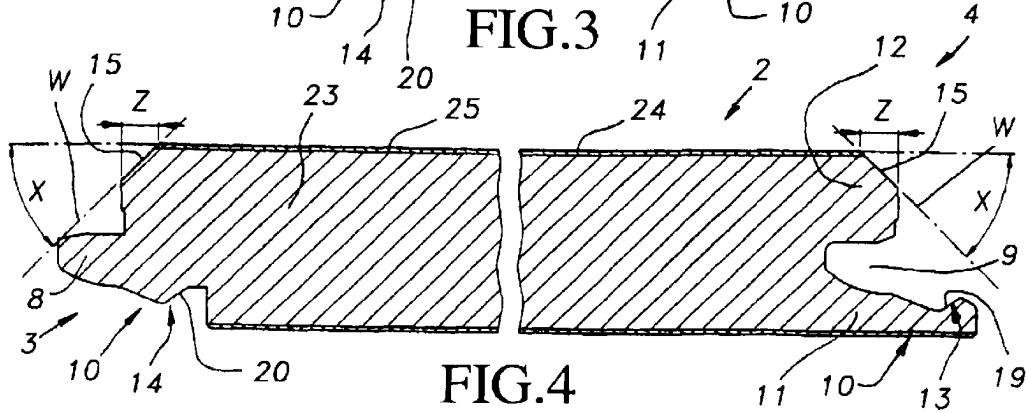
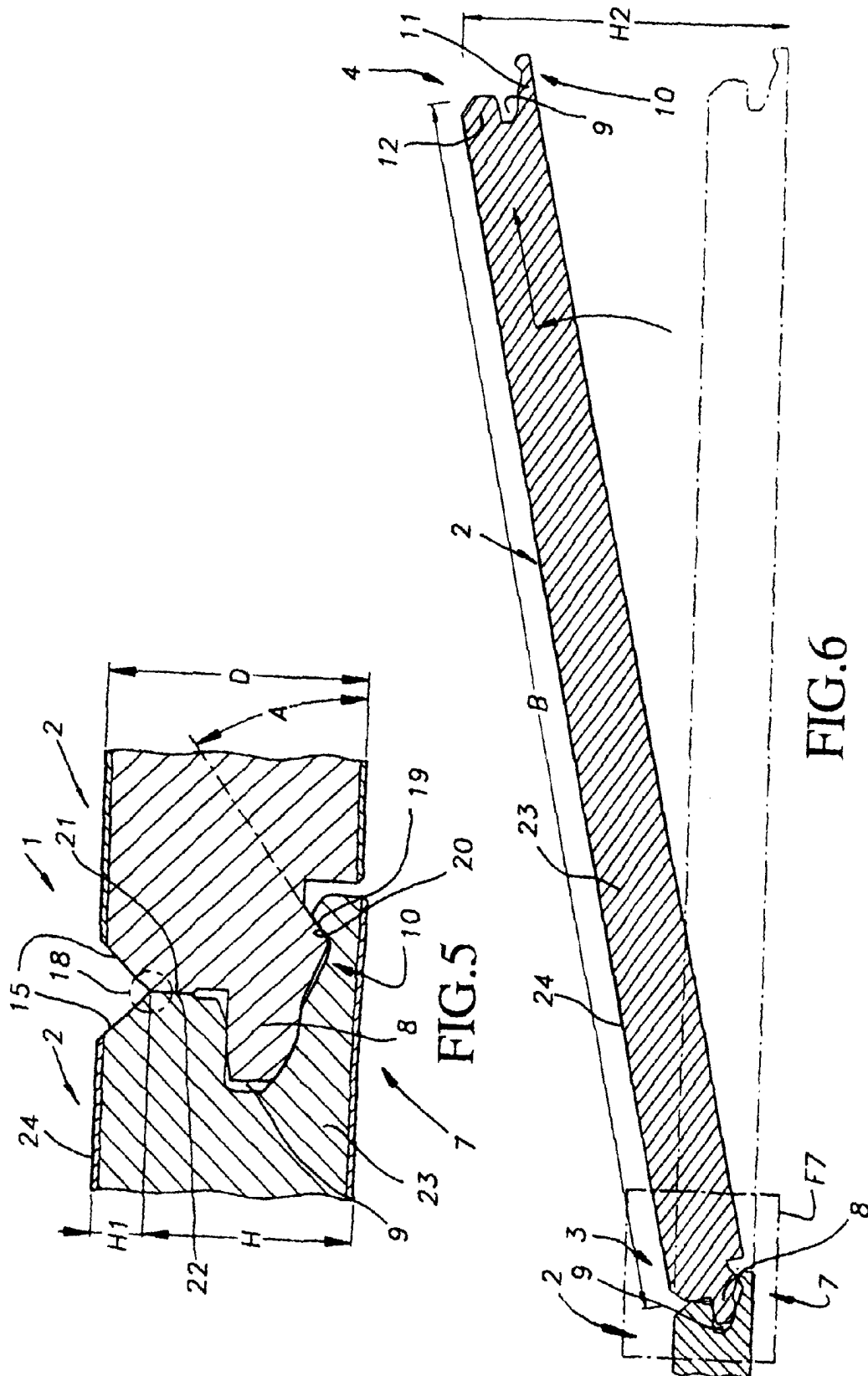


FIG. 4

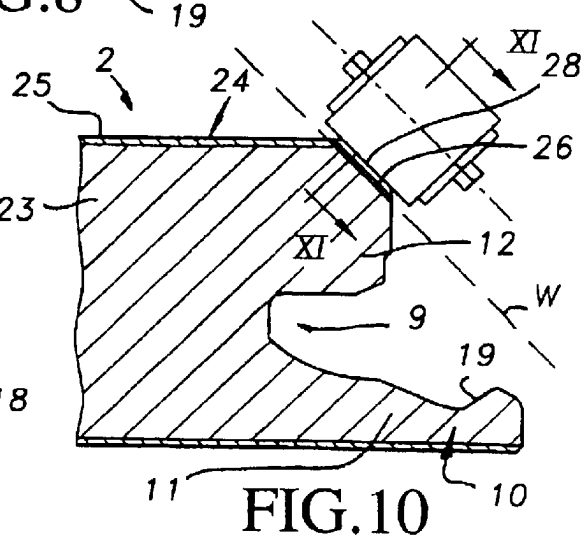
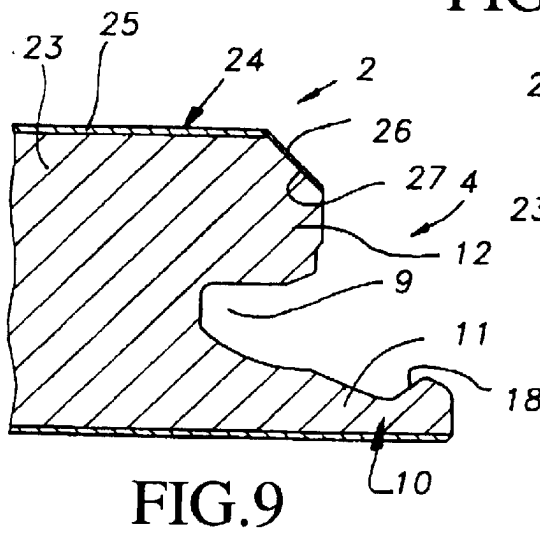
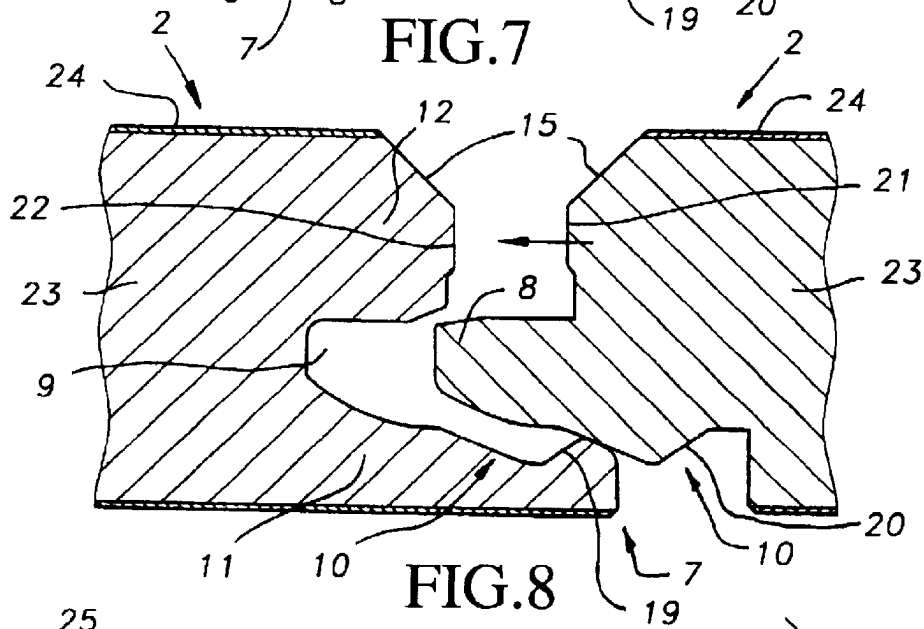
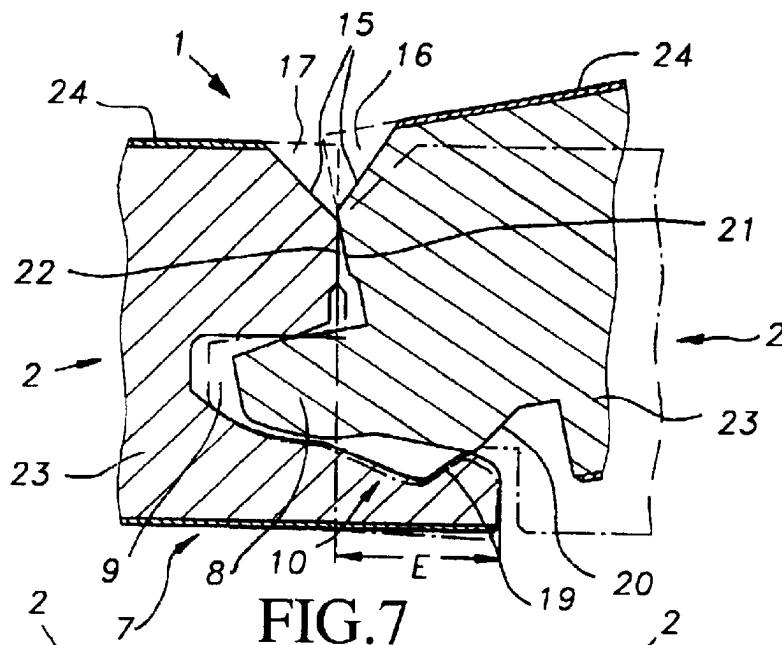


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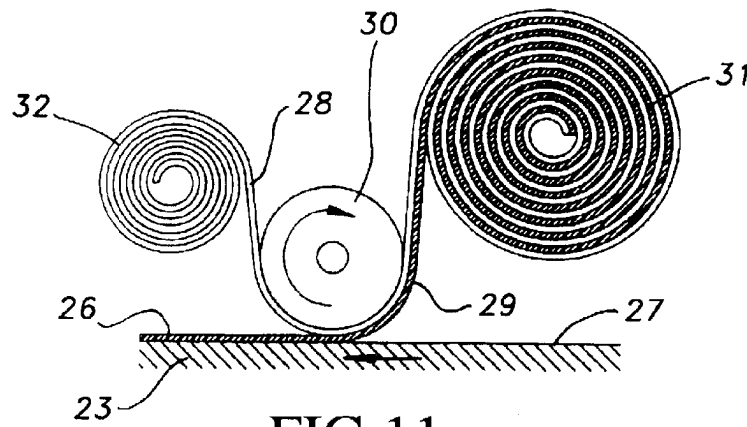


FIG. 11

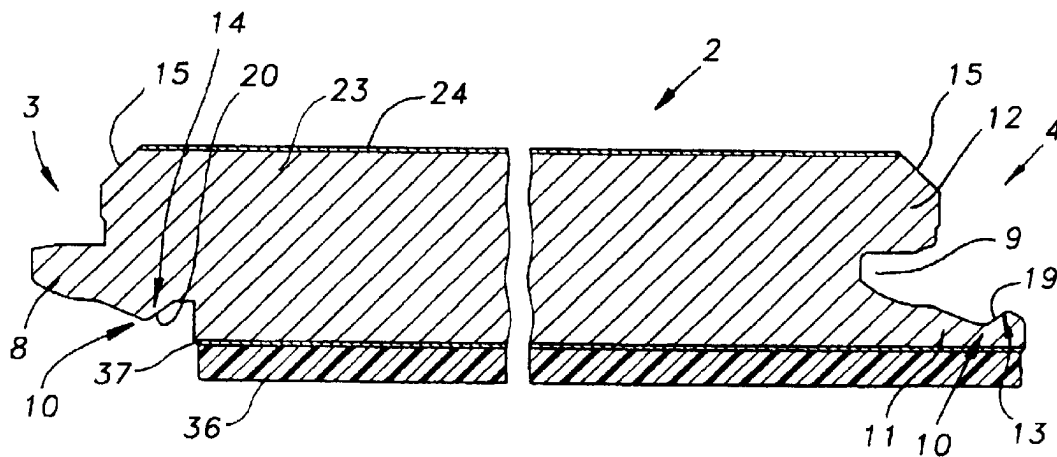


FIG. 12

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FLOOR COVERING**BACKGROUND OF THE INVENTION**

1. Field of the Invention

The present invention concerns floor covering panels, in particular hard laminate panels.

2. Related Art

It is known that such laminate panels can be made of different layers. Usually, the panels are formed of boards based on wood products, such as chipboard or fibreboard, in particular MDF or HDF (medium density fiberboard and high density fiberboard), upon which one or several layers, including a panel decorative layer, are provided at least on the top side. The panel decorative layer may be a printed paper layer, but in certain embodiments it may just as well be a layer of wood, in particular veneer. Such panels can also be made of other materials, for example merely synthetic material, or of a base plate having a wood base, such as chipboard, MDF or HDF and the like, upon which is provided, instead of a printed paper layer or veneer, another material such as cork, thin strips of wood and the like.

It is also known to couple these panels on their edges as they are laid, either by means of a conventional tongue and groove joint, whereby they are possibly glued together, either by means of a glueless coupling which provides for a mutual interlocking of the panels both in the horizontal and vertical direction, for example as described in international patent Publication No. WO 97/47934.

SUMMARY OF THE DISCLOSURE

The present invention relates to hard laminate panels for forming a floor covering and which provides for new embodiments according to different aspects offering respective-advantages.

According to a first aspect, the invention provides for a floor panel comprising at least on two opposite edges having coupling means or elements made in one piece with the panels, so that several ones of such panels can be mutually coupled at such edges, whereby these coupling elements provide for an interlocking in a direction perpendicular to the plane of the floor covering, as well as in a direction perpendicular to the edges concerned and parallel to the plane of the floor covering, and whereby these coupling elements are made such that the panels can be rotated into and/or out of one another at least along the above-mentioned edges, and wherein the panels are provided, at least on the above-mentioned edges, near the top side, with a part from which has been removed an amount of material (e.g., a bevel).

With material removed from the top edge, several advantages are obtained. A first advantage consists in that the panels, as they are rotated, both when rotating into one another and when rotating out of one another, can be moved more easily in relation to one another, as there are no angular edges anymore which hinder the mutual rotation of the panels. A second advantage consists in that the panels can be made heavier, in particular thicker than as usual, as the thickness of the panels, thanks to the bevel, has little or no influence anymore on the good working order of the above-mentioned coupling means, during the rotating in and/or the rotating out.

Preferably, the above-mentioned parts consist of bevels, in particular with a gradient of 45°. Practically, the bevels preferably extend, in a horizontal direction, over a distance

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of at least 1 millimeter. Preferably, however, this distance is in the order of magnitude of 2 millimeter.

According to a different variant of the first aspect of the invention, the coupling elements are made such that the panels, instead of being disconnectable at least by a rotation, can be disconnected from one another at least in one other manner. Even then, the above-mentioned bevel still offers certain advantages, as will become clear from the following description.

According to the most preferred embodiment, the panels are rectangular and are provided with the above-mentioned parts, that is, the above-mentioned bevels, respectively, on all four-sides.

According to a second aspect which can either or not be combined with the first aspect, the invention provides for a floor covering panel comprising a hard panel with a core upon which is provided a panel decorative layer, whereby these panels are rectangular and elongated and are provided with coupling means at least on the two opposite longitudinal edges, so that several ones of such panel can be mutually coupled to one another, whereby these coupling elements provide for an interlocking in a direction perpendicular to the plane of the floor covering, as well as in a direction perpendicular to the edges concerned and parallel to the plane of the floor covering, and whereby these coupling elements are made such that each panel can be coupled to and/or uncoupled from another similar panel by means of a rotation along their opposed longitudinal edges, and the width of the panels is smaller than 17 cm, and preferably even smaller than 16 cm.

Further, the panel, apart from the above-mentioned maximum width, preferably has a length which amounts to at least eight times the width.

It is known that hard panels, which are equipped with coupling elements which provide for a horizontal and a vertical interlocking on at least two of their edges, are made as relatively small plates with a width of 19 to 20 cm and a length of 1.20 to 1.40 m. It is also known that the plates, when being laid, have to be occasionally rotated into one another and out of one another so as to make them fit against a wall, skirting board or the like. A disadvantage of the known embodiments of the above-mentioned plates consists in that it is often difficult to carry out said rotation, for example when the plates have to be installed with their far ends under the edge of an overhanging cupboard or such. According to the above-mentioned second aspect of the invention, this disadvantage, as well as others, are avoided, if not minimised. Thanks to the small width, the panels are less high when being rotated, so that there are no disadvantages during the installation in a large number of practical applications.

Moreover, the above-mentioned relation between length and width offers a technical solution, as a result of which the visual 'plate-like' effect is excluded.

According to a third aspect of the invention, floor covering panels having a laminated structure include a panel decorative layer on the top surface, and bevels or such are formed as by cutting away on one or several edges of the panels, near the top side and the surface of these bevels is also provided with a bevel film or coating-like decorative layer, preferably a layer provided as a separate material and separate from the panel decorative layer. In particular, such a layer preferably consists of a separately provided print. Thanks to the use of such a separate print, the bevels can be easily provided with a bevel decorative surface. The base panels can then be made in a conventional manner by sawing

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them out of a large plate which has already been provided with a panel decorative layer, and the bevels may be printed later.

According to a major embodiment of the third aspect, the above-mentioned print consists of a print which is obtained by means of transfer printing. Such transfer printing offers the advantage, in combination with its use on floor panels, that high production rates can be obtained and that any pattern whatsoever can be realized. Further, this technique excludes the risk of the decorative top surface of the panels being soiled. Another major advantage hereby consists in that the print is immediately or almost immediately dry, so that the panels can be stacked and packed almost immediately.

Preferably, the floor panels, which are made according to the third aspect of the invention, have a core made of a material having a wood base, in particular wood which has been ground into particles or fibres, mixed with a binding agent, upon which the decorative layer is provided, and whereby the above-mentioned bevels extend through the material of the core. Thus a porous surface is obtained on the bevels, guaranteeing a good bond for the print layer.

As usual, the decorative layer of the panel preferably contains a layer printed with a pattern, such as a wood pattern, and the decorative layer according to the invention, in particular the print on the bevels or such, is preferably a similar pattern.

Moreover, use is preferably made of a moisture-proof, impermeable bevel decorative layer or print respectively, which is particularly advantageous in case the panels have a base plate which consists of porous material, such as MDF, HDF (medium density fiberboard and high density fiberboard) or the like. Thus is obtained an entirely moisture-proof structure on the top surface, on the flat surface by means of the usual layer of synthetic material on the one hand, and on the bevels by means of the additional bevel decorative layer situated on the bevel on the other hand.

Although the decorative layer on the bevels is preferably realized by means of transfer printing, other possibilities are not excluded. Thus, for example, use can be made of a self-adhesive strip.

According to a fourth aspect, the invention provides for a floor covering panel having a core made of MDF or HDF, or a similar material, wherein the panel is provided with an underlayer provided on the bottom side and fixed onto it, preferably made of polyethylene or a polyethylene based material. The combination of MDF or HDF with the use of an underlayer fixed onto it, especially when it is formed of polyethylene or is made on the basis of polyethylene, offers the advantage that particularly good sound-insulating qualities are obtained.

The present invention concerns embodiments applying only one of the above-mentioned aspects as well as embodiments in which two or several of the above-mentioned aspects are combined. In this respect it should be noted that two or several of the above-mentioned embodiments can be mutually combined at random, in any possible combination, provided these embodiments have no contradictory qualities.

Although, according to some of the above-mentioned aspects, the panels may consist of different sorts of material, the invention is particularly suitable for panels made of MDF or HDF, or a similar material.

According to a special embodiment, the panels have a thickness of 9 mm at the least, and better still of 10 mm at the least, as opposed to the usual thickness of 7 or 8 mm.

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Thus are obtained relatively heavy panels, which consequently have a better sound-insulating effect, as a result of which less sound is produced when they are walked on.

In so far as coupling means as mentioned above are used which allow for a glueless interlocking, they can be of different nature. Thus, these coupling means can have one of the following characteristics or a combination of two or several of them:

that they are provided on two opposite edges of the panels;

that they are provided on panels which are rectangular, whereby they are provided on both pairs of opposite edges;

that at least for a number of the edges they allow for an assembly according to one of the following possibilities:

at least by shifting the panels towards one another;

exclusively by shifting the panels towards one another;

at least by rotating the panels along the edges concerned;

exclusively by rotating the panels along the edges concerned;

by shifting the panels towards one another or by rotating them, as desired;

that, at least for a number of the edges, they allow for an uncoupling according to any of the following possibilities:

at least by shifting the panels but of one another in a direction perpendicular to the edges;

exclusively by shifting the panels out of one another in a direction perpendicular to the edges;

at least by rotating the panels along the edges concerned;

exclusively by rotating the panels along the edges concerned;

by shifting the panels out of one another as well as by rotating them;

that they are of the type which consists of a tongue and a groove on the one hand, and of locking means which ensure at least a specific interlocking in a direction perpendicular to the edges of the coupled panels and parallel to the plane of the panels on the other hand;

that they are realized as in the preceding paragraph, whereby the lip which limits the bottom side of the groove, seen from a cross section, extends past the upper lip, and whereby the locking means consist of one or several parts on the lip limiting the bottom side of the groove on the one hand, and of one or several parts on the bottom side of the tongue working in conjunction with the latter on the other hand;

that the above-mentioned tongue and groove are made such that when two of such panels are freely shifted towards one another, over a base or such, the tongue automatically is introduced into the groove;

that they are formed such that the panels, when coupled, fit into one another without any play or almost without any play.

Naturally, the invention also concerns panels with which the above-described floor coverings can be realized.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to better explain the characteristics of the invention, the following preferred embodiments are described as an example only without being limitative in any way, with reference to the accompanying drawings, in which:

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FIG. 1 schematically represents a part of a floor covering which is built up of panels according to the invention;

FIG. 2 represents a top view of a panel from the floor covering of FIG. 1;

FIGS. 3 and 4 represent sections, according to lines III—III and IV—IV respectively in FIG. 2;

FIG. 5 represents a section according to line V—V in FIG. 1 to a larger scale;

FIG. 6 represents a section according to line VI—VI in FIG. 1 to a larger scale;

FIG. 7 represents the part indicated by F7 in FIG. 6 to a larger scale;

FIG. 8 shows a view analogous to that in FIG. 7, but whereby the panels are mainly shifted towards one another in one and the same plane;

FIG. 9 shows a section of another panel according to the invention, with bevels which are provided with a print;

FIG. 10 schematically represents how the print can be provided in the embodiment of FIG. 9;

FIG. 11 schematically represents a section according to line XI—XI in FIG. 10; and

FIG. 12 represents a section of another panel according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

As represented in FIGS. 1 and 2, the invention concerns a floor covering 1 as well as hard panels 2 from which such a floor covering 1 is built up.

According to a first aspect of the invention, a floor covering 1 is formed of hard laminate panels 2, wherein these panels 2 are provided at least on two opposite edges 3-4, and preferably, as represented in the FIGS. 2 to 8, on both pairs of edges 3-4, 5-6 respectively, with coupling means 7 made in one piece out of the core material of the panels 2, so that several of such panels 2 can be mutually coupled to one another, whereby these coupling means 7 provide for an interlocking in a direction R1 perpendicular to the plane of the floor covering 1, as well as in, a direction R2 perpendicular to the edges 3-4 or 5-6 concerned and parallel to the plane of the floor covering 1 or panels 2, and whereby these coupling means 7 are made such that the panels 2 can be assembled and/or disassembled at least along the above-mentioned edges 3-4, 5-6 respectively, by means of a rotation.

Such coupling means 7, which make it possible to couple the panels 2 without any glue being required, at least on two sides and preferably on all sides, and whereby the panels 2 are uncoupled by rotating them out of one another, are known as such from international patent Publication No. WO 97/47834.

From WO 97/47834 it is also known that the above-mentioned coupling means 7, as represented in FIGS. 3 to 8 of the present application, may consist of a tongue 8 and a groove 9 on the one hand, and of locking device 10 on the other hand which at least ensure a specific interlocking in a direction perpendicular to the edges 3-4, 5-6 respectively, of the coupled panels 2 and parallel to the plane of these panels 2. As is further represented, these coupling means 7 are moreover preferably made such that the lip 11 which limits or defined the bottom side of the groove 9, seen from a cross section, extends past the upper lip 12, while the locking means 10 are formed of interlocking parts 13-14 working in conjunction, on the above-mentioned lip 11

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which limits the bottom side of the groove 9 and on the bottom side of the coupled panel 2 respectively, in particular the bottom side of the tongue 8 or the extension of this bottom side.

As explained in WO 97/4834, such coupling means 7, depending on their embodiment, allow for different couplings. According to the most preferred embodiment, they are, as will be described hereafter by means of FIG. 1, made such that they allow for a coupling by rotating into one another as well as by shifting towards one another in a generally common plane. The latter allows such panels to be coupled by first rotating them into one another on their edges 3-4, as represented by the panel 2A in FIG. 1, with a rotation W1, and by subsequently snapping them together on their edges 5-6 by means of a translation T1. According to a variant, the connection on the edges 3-4 of the panels concerned can also be realized by starting from a position as is schematically indicated with reference 2B, and by coupling the panel concerned by means of a translation or sliding motion T2.

The above-mentioned rotation is further illustrated in FIGS. 6 and 7, whereas the sliding motion is represented in FIG. 8. It should be noted that the tongue 8 and groove 9 are preferably made such that, as is also represented in FIG. 8, when two such panels 2 are freely shifted towards one another over a bottom or support, the tongue 8 automatically is introduced into and ends up in the groove 9.

It is also possible, while holding a panel 2A in a rotated position, to couple a following panel 2C onto it on the edges 5 and 6 respectively, either by means of a generally co-planar translation T3, or by a mutual rotation between the panels 2A and after which both panels 2A and 2C are then rotated down to be interlocked with the preceding row of panels.

Another advantage consists in that a glueless coupling without any play or practically without any play remains possible, also with thicker panels which can be rotated into and/or out of one another, without any extreme compression forces being created on the edge parts during the rotation. The bevels according to this invention ensure that such forces are excluded and/or remain limited, so that the risk of damages, among others to the top layer or to the surface of the bevels, are excluded, if not restricted.

What makes the first aspect of the invention special is that the above-mentioned panels 2 are provided, at least on two of their edges 3-4 or 5-6 and preferably on all four edges 3 to 6, near the top side, with a part from which an amount of material has been cut-away and removed (a cut-away portion), which part preferably each time is in the form of a bevel 15.

As represented in FIGS. 6 and 7, these bevels 15 among others offer the advantage that the panels 2 can be easily rotated in relation to one another, as the material parts 16 and 17 which are otherwise present no longer press onto one another, and a contact zone 18 is obtained which is situated relatively low in the panel thickness.

Another advantage is that when it is required for the above-mentioned interlocking parts 13 and 14, in particular the accompanying contact surfaces 19 and 20, to extend tangentially or almost tangentially around a circle having the contact zone 18 as its centre, the average gradient A of the contact surfaces can be kept relatively large for a same distance E of the protruding part of the lower lip 11, as indicated in FIG. 5, as a result of which a solid interlocking can be ensured, even with thicker panels 2.

Another advantage consists in that, irrespective of the thickness D of the panels 2, the contact zone 18 can always

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be situated at a certain height H above the bottom side of the panels 2, provided the bevels 15 are realized over an appropriate height H1. Thus it is possible, if required, to always work with similar cutting tools to form the tongue 8 and groove 9, for thinner as well as for thicker 5 panels 2.

Although the above-mentioned advantages are particularly felt with embodiments of the type whereby the uncoupling of the panels 2 can be realized by means of a rotation around the above-mentioned contact zone 18, it should be noted that the above-mentioned bevels 15 also offer advantages which do not necessarily coincide with the fact whether it is either or not possible for the panels 2 to be disassembled by means of rotation. Such bevels 15 offer the advantage that the panels 2 never press directly onto one another on their top surface, so that damage of the top layer resulting from mutual contact between the panels 2 is excluded, which is particularly important in the case of laminate parquet, as well as for floor coverings which are connected without any glue and whereby the panels are driven one another laterally in a generally common plane by means of a hammer and a stop block.

Also, according to a different embodiment, the first aspect of the invention no longer merely applies to panels 2 which can be disassembled by means of a rotation, but it also applies to all sorts of panels 2 which are provided with coupling means 7 which make it possible for the panels 2 to be interlocked both vertically and horizontal on their edges 3-4, 5-6 respectively, irrespective of whether the assembly and/or disassembly has to be or can be realized by means of a rotation or sliding motion.

The above-mentioned bevels 15 preferably extend at an angle X of 45° in relation to the plane which is determined by or includes the panels 2. However, other gradients are not excluded.

Practically, the bevels 15 will extend in a horizontal direction over a distance Z in the order of magnitude of 2 millimeter, although other dimensions are not excluded here either.

As is further represented in FIG. 5, lateral surfaces, in particular contact surfaces 21-22 are present under the above-mentioned bevels 15, which fit up to one another at least at the top when the panels 2 are coupled, and thus form a mutual stop.

It is clear that the first aspect of the invention can be applied with panels 2 having an elongated design, as represented in FIG. 2, as well as with panels 2 having a square design.

According to the above-mentioned second aspect of the invention, which the given example of FIGS. 1 and 2 is combined with the above-mentioned first aspect, but which can also be realized as separate from the first aspect, the invention concerns a floor covering 1, consisting of laminated hard panels 2 having a core 23 and a panel decorative upper surface 24, whereby these panels 2 are rectangular and elongated and are provided with coupling means 7 on at least two opposite longitudinal edges 3-4 and/or 5-6, as a result of which several of such panels 2 can be mutually coupled to one another, whereby these coupling means 7 are provided with an interlocking in a direction perpendicular to the plane of the floor covering 1, as well as in a direction perpendicular to the edges 3-4-5-6 concerned and parallel to the plane of the floor covering, and whereby these coupling means 7 are made such that the panels 2 can be coupled and/or uncoupled by means of a rotation along their longitudinal edges 3-4 and/or 5-6, such that the useful width B of the panels 2 is smaller than 17 cm, and preferably amounts to 15.5 cm.

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Such a narrow width B, combined with coupling means 7 of the type whereby the uncoupling has to be carried out by rotating the panels 2 in relation to one another, as represented in FIG. 6, offers the advantage that the height H2 over which the panel 2 to be uncoupled has to be rotated before it is detached, also remains relatively small, as a result of which the disadvantage mentioned in the introduction is minimised.

Moreover, the panels 2, according to the second aspect of the invention, preferably also have a length L which amounts to at least eight times the width B.

Preferably, the panels 2 made according to the second aspect of the invention, also have a single pattern which is repeated over the entire top surface, in particular a wood pattern.

FIG. 9 illustrates the third aspect of the invention. According to this third aspect, the invention concerns a floor covering 1 consisting of hard panels 2 with a laminated structure, having a panel decorative layer 25 on the top surface, wherein cut-away bevels 15 or such are formed on one or several edges 3 to 6 of the panels 2, near the top side, and in that the exposed surface of these bevels 15 or such is also provided with a bevel decorative layer, in this case a print 26, which is preferably obtained as a print layer that has been provided on this surface by means of transfer printing.

As shown in FIG. 8, the cut-away bevels 15 extend through the core 23 of each panel as well as the panel decorative layers 24, thereby exposing edges of the respective layers 23 and 24. The print layer 26 (FIGS. 9, 10) covers or masks the exposed core and panel decorative edges, preferably matching the pattern of the panel decorative layer so that, when viewed from the top surface, the exposed bevel area is covered by the bevel decorative layer.

The bevel decorative layer 25 may as such consist of several layers, but it preferably contains at least one film or coating-like layer imprinted with a pattern, for example a food pattern printed on a paper layer. In this case, the print 26 can be realized on the bevels 15 or such with a similar pattern. As a printing technique is applied for the decorative layer as well as for the print 26, it is very easy to match both patterns as far as colour and/or design are concerned.

As mentioned in the introduction, the print 26 is preferably moisture-proof and impermeable. Thus is obtained a sealing on the bevels 15, which is particularly useful when the panels have a porous core, for example made of MDF or HDF.

FIGS. 10 and 11 schematically represent how the print 26 can be provided on the surface 27 by means of transfer printing. A support 28 which is provided with a printing layer 29 is put into contact with the surface 27 and is applied with a preferably heated press-n roller 30, as a result of which the printing layer 29 adheres to the material of the panel 2 and comes off the support 28, so that the above-mentioned print 26 is created. The support 28 with the printing layer 29 is hereby supplied as of a roller 31, whereas said support 28, after the printing layer 29 has been transferred to the surface 27, is rolled up on a roller 32.

Other transfer printing techniques which are known as such are not excluded, however.

It should be noted that, both as far as the above-mentioned first aspect and the third aspect are concerned, according to a preferred embodiment, one or several, and preferably all bevels 15 extend at such an angle that the plane including the bevel 15, does not intersect the contour of the panel 2 or at most just touches it, as indicated by the lines W in FIGS. 3, 4 and 10 outside the bevel area. This is advantageous in that,

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both when the bevels **15** are formed and when the print **26** is applied, these bevels **15** are easily accessible to the machine parts used in the manufacturing procedures.

According to a fourth aspect of the invention, it concerns a floor covering consisting of laminated hard panels **2** with a core **23** based on MDF or HDF, or a similar material, wherein the panels **2** are each separately provided with an underlayer **36** made of synthetic material or another dampening or insulating material provided on the bottom side and fixed onto it, preferably made of polyethylene or polyethylene base material, as represented in FIG. **12**. The combination of these materials offers the advantage that little sound is produced when these panels **2** are walked on.

The above-mentioned underlayer **36** can be fixed to the bottom side of the panel **2** in any way whatsoever, for example by means of gluing or by melting it onto the panel. In the case of a conventional laminate construction, the structure thus consists of the decorative layer **25**, the core **23**, usually based on MDF or HDF, a counterlayer **37**, and the above-mentioned underlayer **36**.

It is clear that the fourth aspect of the invention can be used in combination with floor panels which are provided with a conventional tongue and groove on their edges, as well as in combination with floor panels with coupling means which provide for a horizontal and a vertical interlocking, for example coupling means **7** as described above.

The invention is by no means limited to the above-described embodiments represented on the accompanying drawings; on the contrary, such a floor and in particular the above-mentioned panels, can be made in all shapes and dimensions while still remaining within the scope of the invention.

What is claimed is:

1. A floor covering panel comprising a top side, at least two opposite edges including coupling elements made in one piece with the panel and arranged so that several ones of such panels can be mutually coupled to form a floor covering, said coupling elements arranged to enable an interlocking of the coupling elements between panels in a direction perpendicular to a plane including the panels, as well as in a direction perpendicular to the respective edges and parallel to the plane including the panels, and wherein said panel is a laminated construction including at least an MDF/HDF core layer and a panel decorative layer above the core layer;

said coupling elements are formed in one piece with the core layer and define tongue and groove interlocking elements;

a cut-away portion adjacent at least one of said two opposite edges, and intersecting said top side, said cut-away portion penetrating and exposing an edge area of said panel decorative layer and said core layer when viewed from the top side of the panel; and

a film or coating-like decorative cut-away portion covering layer on the area of the cut-away portion masking said exposed edge area, said decorative cut-away portion covering layer being a separate layer from said panel decorative layer.

2. The floor covering panel according to claim 1, wherein each cut-away portion comprises a bevel extending at an angle of 45° in relation to the plane including the panel.

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3. The floor covering panel according to claim 2, wherein each cut-away portion, in the plane of the respective panel, extends over a distance of about 2 millimeter.

4. The floor covering panel according to claim 1, wherein the coupling elements when coupled between ones of said panel, are disconnectable at least in one additional manner other than rotation relative to the coupled edges of the panels.

5. The floor covering panel according to claim 1, wherein the panel is rectangular and said cut-away portion is provided on all four sides of the panels.

6. The floor covering panel according to claim 1, wherein each cut-away portion is a bevel extending at an angle so that the plane including the bevel does not intersect any other portion of the respective edge section of the panel at which the bevel is provided.

7. A floor covering panel according to claim 1, comprising a bottom side, wherein the panel is separately provided with an underlayer attached to the bottom side, said underlayer being polyethylene or polyethylene based material.

8. The floor panel covering according to claim 1, wherein the panel has a minimum thickness of 9 mm.

9. The floor covering panel according to claim 1, wherein the panel has a minimum thickness of 10 mm.

10. The floor covering panel according to claim 1, wherein the coupling elements are configured so that the panels can be rotated in or out of one another at least along said opposite edges.

11. The floor covering panel according to claim 10, wherein said panel is rectangular and elongated, and wherein the width of the panel is smaller than 17 cm.

12. The floor covering panel according to claim 1, wherein said panel is rectangular and elongated and includes said coupling elements on at least two opposite longitudinal edges of the panel, such that several ones of such panel can be mutually coupled to one another along said edges, and wherein the coupling elements are configured such that individual panels can be coupled and/or uncoupled with similar panels by means of rotation motion about cooperating opposed longitudinal edges of the panels, and wherein the width of the panel (**2**) is smaller than 17 cm.

13. The floor covering panel according to claim 1, including a cut-away portion adjacent at least two opposed edges.

14. The floor covering panel according to claim 1, wherein the decorative cut-away portion covering layer comprises a print.

15. The floor covering panel according to claim 14, wherein said print is a transfer layer.

16. The floor covering panel according to claim 1, wherein the panel decorative layer of the top core surface comprises a paper layer printed with a pattern.

17. The floor covering panel according to claim 1, wherein the decorative cut-way portion covering layer represents a print on each cut-print portion and wherein this provided with a pattern similar to the pattern of the panel decorative layer.

18. The floor covering panel according to claim 1, wherein the decorative cut-way portion covering layer is a moisture-proof impermeable layer.

* * * * *

JS 44 (Rev. 12/07)

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. (SEE INSTRUCTIONS ON THE REVERSE OF THE FORM.)

I. (a) PLAINTIFFS

Unilin Beheer B.V. and Flooring Industries Ltd., sarl

(b) County of Residence of First Listed Plaintiff _____
(EXCEPT IN U.S. PLAINTIFF CASES)

(c) Attorney's (Firm Name, Address, and Telephone Number)
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DEFENDANTS

Pergo (Europe) AB and Pergo LLC

County of Residence of First Listed Defendant _____
(IN U.S. PLAINTIFF CASES ONLY)

NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE
LAND INVOLVED.

Attorneys (If Known)

II. BASIS OF JURISDICTION (Place an "X" in One Box Only)

- ☐ 1 U.S. Government Plaintiff ☒ 3 Federal Question (U.S. Government Not a Party)
- ☐ 2 U.S. Government Defendant ☐ 4 Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (Place an "X" in One Box for Plaintiff and One Box for Defendant)

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| Citizen of This State | <input type="checkbox"/> 1 | <input type="checkbox"/> 1 | Incorporated or Principal Place of Business In This State | <input type="checkbox"/> 4 | <input type="checkbox"/> 4 |
| Citizen of Another State | <input type="checkbox"/> 2 | <input type="checkbox"/> 2 | Incorporated and Principal Place of Business In Another State | <input type="checkbox"/> 5 | <input type="checkbox"/> 5 |
| Citizen or Subject of a Foreign Country | <input type="checkbox"/> 3 | <input type="checkbox"/> 3 | Foreign Nation | <input type="checkbox"/> 6 | <input type="checkbox"/> 6 |

IV. NATURE OF SUIT (Place an "X" in One Box Only)

| CONTRACT | TORTS | FORFEITURE/PENALTY | BANKRUPTCY | OTHER STATUTES | |
|--|--|---|--|--|--|
| <input type="checkbox"/> 110 Insurance <input type="checkbox"/> 120 Marine <input type="checkbox"/> 130 Miller Act <input type="checkbox"/> 140 Negotiable Instrument <input type="checkbox"/> 150 Recovery of Overpayment & Enforcement of Judgment <input type="checkbox"/> 151 Medicare Act <input type="checkbox"/> 152 Recovery of Defaulted Student Loans (Excl. Veterans) <input type="checkbox"/> 153 Recovery of Overpayment of Veteran's Benefits <input type="checkbox"/> 160 Stockholders' Suits <input type="checkbox"/> 190 Other Contract <input type="checkbox"/> 195 Contract Product Liability <input type="checkbox"/> 196 Franchise | PERSONAL INJURY <input type="checkbox"/> 310 Airplane <input type="checkbox"/> 315 Airplane Product Liability <input type="checkbox"/> 320 Assault, Libel & Slander <input type="checkbox"/> 330 Federal Employers' Liability <input type="checkbox"/> 340 Marine <input type="checkbox"/> 345 Marine Product Liability <input type="checkbox"/> 350 Motor Vehicle <input type="checkbox"/> 355 Motor Vehicle Product Liability <input type="checkbox"/> 360 Other Personal Injury CIVIL RIGHTS <input type="checkbox"/> 441 Voting <input type="checkbox"/> 442 Employment <input type="checkbox"/> 443 Housing/Accommodations <input type="checkbox"/> 444 Welfare <input type="checkbox"/> 445 Amer. w/Disabilities - Employment <input type="checkbox"/> 446 Amer. w/Disabilities - Other <input type="checkbox"/> 440 Other Civil Rights | PERSONAL INJURY <input type="checkbox"/> 362 Personal Injury - Med. Malpractice <input type="checkbox"/> 365 Personal Injury - Product Liability <input type="checkbox"/> 368 Asbestos Personal Injury Product Liability PERSONAL PROPERTY <input type="checkbox"/> 370 Other Personal Property <input type="checkbox"/> 371 Truth in Lending <input type="checkbox"/> 380 Other Personal Property Damage <input type="checkbox"/> 385 Property Damage Product Liability PRISONER PETITIONS <input type="checkbox"/> 510 Motions to Vacate Sentence <input type="checkbox"/> 530 General <input type="checkbox"/> 535 Death Penalty <input type="checkbox"/> 540 Mandamus & Other <input type="checkbox"/> 550 Civil Rights <input type="checkbox"/> 555 Prison Condition | <input type="checkbox"/> 610 Agriculture <input type="checkbox"/> 620 Other Food & Drug <input type="checkbox"/> 625 Drug Related Seizure of Property 21 USC 881 <input type="checkbox"/> 630 Liquor Laws <input type="checkbox"/> 640 R.R. & Truck <input type="checkbox"/> 650 Airline Regs. <input type="checkbox"/> 660 Occupational Safety/Health <input type="checkbox"/> 661 Other (D.N.C.) LABOR <input type="checkbox"/> 720 Labor/Mgmt. Relations Act <input type="checkbox"/> 730 Labor/Mgmt. Reporting & Disclosure Act <input type="checkbox"/> 740 Railway Labor Act <input type="checkbox"/> 790 Other Labor Litigation <input type="checkbox"/> 791 Empl. Ret. Inc. Security Act IMMIGRATION <input type="checkbox"/> 462 Naturalization Application <input type="checkbox"/> 463 Habeas Corpus - Alien Detainee <input type="checkbox"/> 465 Other Immigration Actions | <input type="checkbox"/> 422 Appeal 28 USC 158 <input type="checkbox"/> 423 Withdrawal 28 USC 157 PROPERTY RIGHTS <input type="checkbox"/> 820 Copyrights <input checked="" type="checkbox"/> 830 Patent <input type="checkbox"/> 840 Trademark SOCIAL SECURITY <input type="checkbox"/> 861 HIA (1395ff) <input type="checkbox"/> 862 Black Lung (923) <input type="checkbox"/> 863 DIWC/DIWW (405(g)) <input type="checkbox"/> 864 SSID Title XVI <input type="checkbox"/> 865 RSI (405(g)) FEDERAL TAX SUITS <input type="checkbox"/> 870 Taxes (U.S. Plaintiff or Defendant) <input type="checkbox"/> 871 IRS—Third Party 26 USC 7609 | <input type="checkbox"/> 400 State Reapportionment <input type="checkbox"/> 410 Antitrust <input type="checkbox"/> 430 Banks and Banking <input type="checkbox"/> 450 Commerce <input type="checkbox"/> 460 Deportation <input type="checkbox"/> 470 Racketeer Influenced and Corrupt Organizations <input type="checkbox"/> 480 Consumer Credit <input type="checkbox"/> 490 Cable/Sat TV <input type="checkbox"/> 810 Selective Service <input type="checkbox"/> 850 Securities/Commodities/Exchange <input type="checkbox"/> 875 Customer Challenge 12 USC 3410 <input type="checkbox"/> 890 Other Statutory Actions <input type="checkbox"/> 891 Agricultural Acts <input type="checkbox"/> 892 Economic Stabilization Act <input type="checkbox"/> 893 Environmental Matters <input type="checkbox"/> 894 Energy Allocation Act <input type="checkbox"/> 895 Freedom of Information Act <input type="checkbox"/> 900 Appeal of Fee Determination Under Equal Access to Justice <input type="checkbox"/> 950 Constitutionality of State Statutes |

V. ORIGIN

(Place an "X" in One Box Only)

- ☒ 1 Original Proceeding ☐ 2 Removed from State Court ☐ 3 Remanded from Appellate Court ☐ 4 Reinstated or Reopened ☐ 5 Transferred from another district (specify) ☐ 6 Multidistrict Litigation ☐ 7 Appeal to District Judge from Magistrate Judgment

VI. CAUSE OF ACTION

Cite the U.S. Civil Statute under which you are filing (Do not cite jurisdictional statutes unless diversity):
35 U.S.C. § 101 et seq.

Brief description of cause:
Patent infringement

VII. REQUESTED IN COMPLAINT:

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DEMAND \$

CHECK YES only if demanded in complaint:

JURY DEMAND: ☒ Yes ☐ No**VIII. RELATED CASE(S) IF ANY**

1:08-cv-00399-RCL (D.D.C.); 1:08-cv-00659-RCL (D.D.C.); 5:08-cv-00091-RCL (E.D.N.C.)

(See instructions):

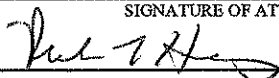
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RECEIPT # _____ AMOUNT _____ APPLYING IFP _____ JUDGE _____ MAG. JUDGE _____

INSTRUCTIONS FOR ATTORNEYS COMPLETING CIVIL COVER SHEET FORM JS 44**Authority For Civil Cover Sheet**

The JS 44 civil cover sheet and the information contained herein neither replaces nor supplements the filings and service of pleading or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. Consequently, a civil cover sheet is submitted to the Clerk of Court for each civil complaint filed. The attorney filing a case should complete the form as follows:

I. (a) Plaintiffs-Defendants. Enter names (last, first, middle initial) of plaintiff and defendant. If the plaintiff or defendant is a government agency, use only the full name or standard abbreviations. If the plaintiff or defendant is an official within a government agency, identify first the agency and then the official, giving both name and title.

(b) County of Residence. For each civil case filed, except U.S. plaintiff cases, enter the name of the county where the first listed plaintiff resides at the time of filing. In U.S. plaintiff cases, enter the name of the county in which the first listed defendant resides at the time of filing. (NOTE: In land condemnation cases, the county of residence of the "defendant" is the location of the tract of land involved.)

(c) Attorneys. Enter the firm name, address, telephone number, and attorney of record. If there are several attorneys, list them on an attachment, noting in this section "(see attachment)".

II. Jurisdiction. The basis of jurisdiction is set forth under Rule 8(a), F.R.C.P., which requires that jurisdictions be shown in pleadings. Place an "X" in one of the boxes. If there is more than one basis of jurisdiction, precedence is given in the order shown below.

United States plaintiff. (1) Jurisdiction based on 28 U.S.C. 1345 and 1348. Suits by agencies and officers of the United States are included here.

United States defendant. (2) When the plaintiff is suing the United States, its officers or agencies, place an "X" in this box.

Federal question. (3) This refers to suits under 28 U.S.C. 1331, where jurisdiction arises under the Constitution of the United States, an amendment to the Constitution, an act of Congress or a treaty of the United States. In cases where the U.S. is a party, the U.S. plaintiff or defendant code takes precedence, and box 1 or 2 should be marked.

Diversity of citizenship. (4) This refers to suits under 28 U.S.C. 1332, where parties are citizens of different states. When Box 4 is checked, the citizenship of the different parties must be checked. (See Section III below; federal question actions take precedence over diversity cases.)

III. Residence (citizenship) of Principal Parties. This section of the JS 44 is to be completed if diversity of citizenship was indicated above. Mark this section for each principal party.

IV. Nature of Suit. Place an "X" in the appropriate box. If the nature of suit cannot be determined, be sure the cause of action, in Section VI below, is sufficient to enable the deputy clerk or the statistical clerks in the Administrative Office to determine the nature of suit. If the cause fits more than one nature of suit, select the most definitive.

V. Origin. Place an "X" in one of the seven boxes.

Original Proceedings. (1) Cases which originate in the United States district courts.

Removed from State Court. (2) Proceedings initiated in state courts may be removed to the district courts under Title 28 U.S.C., Section 1441. When the petition for removal is granted, check this box.

Remanded from Appellate Court. (3) Check this box for cases remanded to the district court for further action. Use the date of remand as the filing date.

Reinstated or Reopened. (4) Check this box for cases reinstated or reopened in the district court. Use the reopening date as the filing date.

Transferred from Another District. (5) For cases transferred under Title 28 U.S.C. Section 1404(a). Do not use this for within district transfers or multidistrict litigation transfers.

Multidistrict Litigation. (6) Check this box when a multidistrict case is transferred into the district under authority of Title 28 U.S.C. Section 1407. When this box is checked, do not check (5) above.

Appeal to District Judge from Magistrate Judgment. (7) Check this box for an appeal from a magistrate judge's decision.

VI. Cause of Action. Report the civil statute directly related to the cause of action and give a brief description of the cause. **Do not cite jurisdictional statutes unless diversity.** Example: U.S. Civil Statute: 47 USC 553
Brief Description: Unauthorized reception of cable service

VII. Requested in Complaint. Class Action. Place an "X" in this box if you are filing a class action under Rule 23, F.R.Cv.P.

Demand. In this space enter the dollar amount (in thousands of dollars) being demanded or indicate other demand such as a preliminary injunction.

Jury Demand. Check the appropriate box to indicate whether or not a jury is being demanded.

VIII. Related Cases. This section of the JS 44 is used to reference related pending cases if any. If there are related pending cases, insert the docket numbers and the corresponding judge names for such cases.

Date and Attorney Signature. Date and sign the civil cover sheet.

AO FORM 85 RECEIPT (REV. 9/04)

United States District Court for the District of Delaware

08 - 004

Civil Action No. _____

ACKNOWLEDGMENT
OF RECEIPT FOR AO FORM 85

NOTICE OF AVAILABILITY OF A
UNITED STATES MAGISTRATE JUDGE
TO EXERCISE JURISDICTION

I HEREBY ACKNOWLEDGE RECEIPT OF 2 COPIES OF AO FORM 85.

5/21/08
(Date forms issued)

X [Signature]
(Signature of Party or their Representative)

X Kevin Reinhold
(Printed name of Party or their Representative)

Note: Completed receipt will be filed in the Civil Action